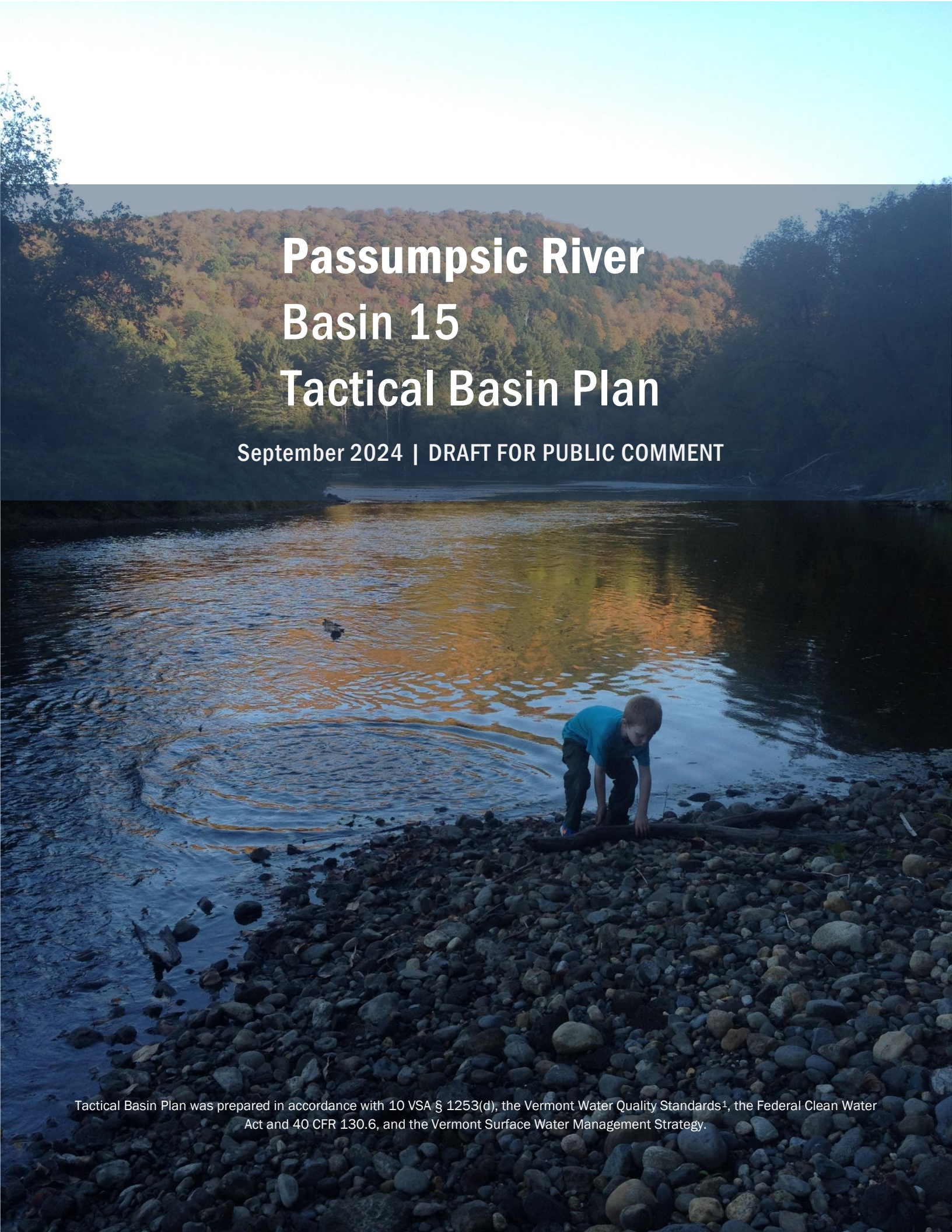

# Passumpsic River Basin 15 Tactical Basin Plan

September 2024 | DRAFT FOR PUBLIC COMMENT

Tactical Basin Plan was prepared in accordance with 10 VSA § 1253(d), the Vermont Water Quality Standards[1], the Federal Clean Water Act and 40 CFR 130.6, and the Vermont Surface Water Management Strategy.

Approved:

Jason Batchelder, Commissioner
Department of Environmental Conservation

Date

Julie S. Moore, P.E., Secretary
Agency of Natural Resources

Date

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**Plan prepared by: Ben Copans, Watershed Planners, VT Agency of Natural Resources**

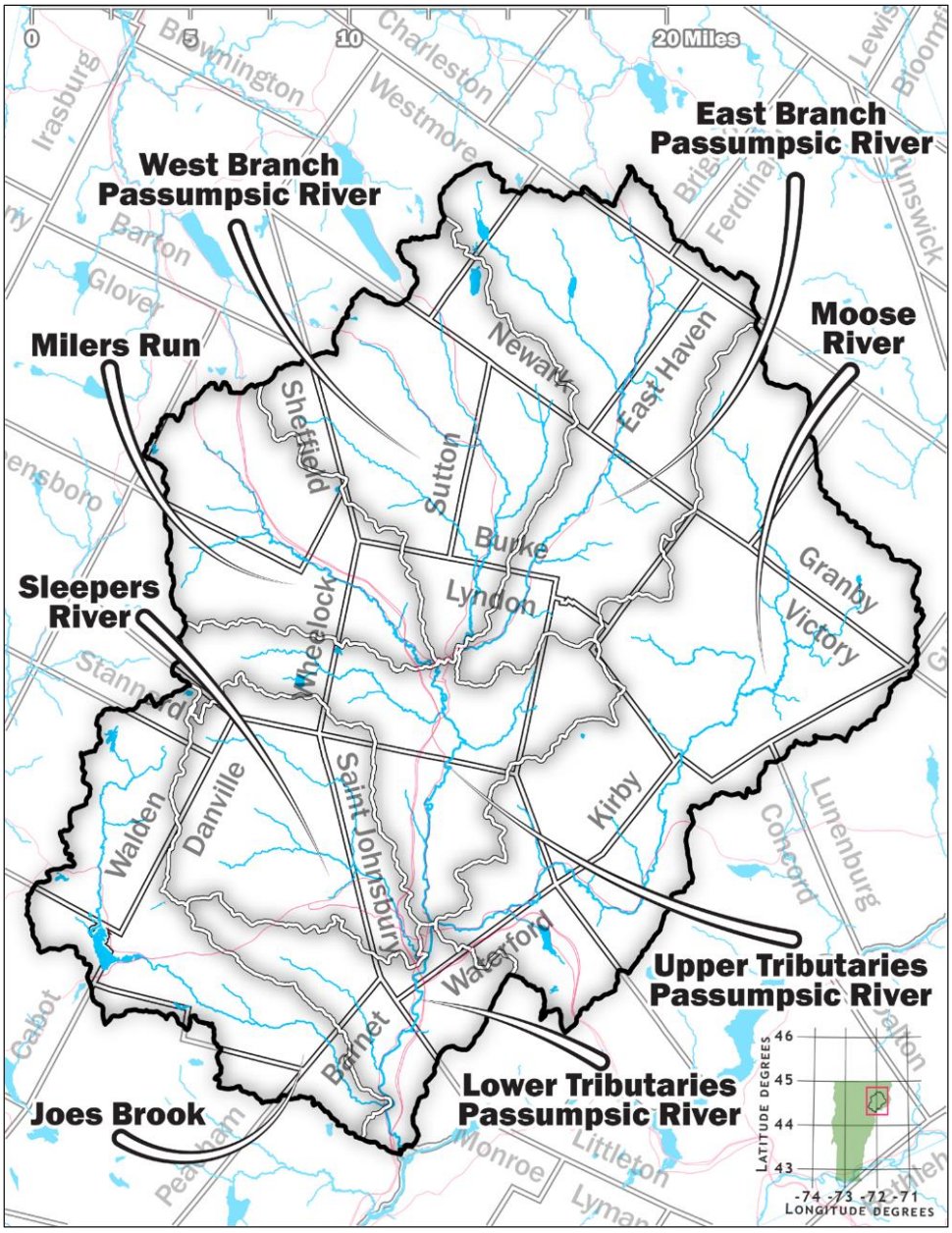
**GIS & Mapping support: Sean Regalado & Phillip Jones, VT Agency of Natural Resources**

**Cover Photo: Passumpsic River in Barnet.**

## Passumpsic River Basin Towns

| | | | |
|---|---|---|---|
| Barnet | Granby | Newark | Walden* |
| Brighton* | Guildhall* | Peacham* | Waterford |
| Burke | Kirby | Saint Johnsbury | Westmore |
| Concord | Cabot | Sheffield | Wheelock |
| East Haven | Danville | Stannard | |
| Ferdinand* | Lunenburg* | Sutton | |
| Glover* | Lyndon | Victory | |

**Only a very small area of the town is in the watershed and is covered in more detail in corresponding basin plans.*



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# Executive Summary

The Passumpsic basin (Basin 15) covers 507 square miles including most of Caledonia County and a portion of Essex County. The Basin includes the East and West Branches of the Passumpsic and Millers Run north of Lyndon and the Moose and Sleepers Rivers that join the Passumpsic River in St Johnsbury along with many smaller streams. This Tactical Basin Plan (TBP) provides a detailed description of current watershed conditions and identifies water quality focused strategies to protect and restore the Basin's surface waters.

Although most surface waters monitored meet or exceed water quality standards, there are waters in need of restoration and continued monitoring. Just two river segments are considered impaired due to Combined Sewer Overflows in St Johnsbury while, three lakes have increasing nutrient trends. Chapter 3 also includes an overview of the Long Island Sound Dissolved Oxygen Total Maximum Daily Load (TMDL), where nitrogen loading from this basin contributes to water quality concern. Major flooding events in 2023 and 2024 significantly impacted communities in the basin highlighting the importance of strategies that are included in this plan that support increased flood resiliance.

Strategies are proposed for the agricultural, developed, and natural resource sectors to meet overall protection and restoration goals, as well as to reduce nitrogen loading, with a focus on voluntary participation and project implementation by watershed partners. Forty-two detailed strategies are recommended for the next five years and summarized in Table 1 below and detailed in Table 11. Fifty-Four monitoring priorities have been identified to fill data gaps, track changes in water quality condition, and identify waters for reclassification and Class I wetland designation.

**Table 1. Focus areas and a summary of strategies for restoration and protection.**

| | Focus Areas | Priority Strategies |
|---|---|---|
| Agriculture | Basin Wide | • Reestablish meetings of the Caledonia and Essex agricultural workgroup<br>• Provide technical support to farmers to implement Nutrient Management Plans (NMPs) and participate in the AAFM Pay for Performance Program.<br>• Assist farmers in accessing farm equipment through local rental programs, cost-shares, or cooperative applications to funding programs.<br>• Increase outreach to farmers to support buffer planting programs, soil health and water quality improvements, and to farms with potential natural resource protection opportunities, such as farm conservation, river corridor protection, and wetland restoration.<br>• Initiate a discussion of agricultural partners and service providers on how to provide support to farmers to optimize nitrogen application to reduce nitrogen loss.<br>• Provide technical assistance to small farms on fencing animals out of surface waters and establishing alternative water supplies. |

| | Focus Areas | Priority Strategies |
|---|---|---|
| Developed Lands - Stormwater | St Johnsbury, Lyndonville, Burke, Concord | • Evaluate the functioning of existing stormwater projects implemented in the watershed and identify operations and maintenance needs.<br>• Support the prioritization, design, and implementation of P-efficient stormwater projects in lakes with increasing nutrient trends and N reduction in other areas of the basin.<br>• Promote campaigns to raise awareness of simple residential stormwater management solutions.<br>• Support evaluating and improving town salt and sand storage facilities to improve stormwater management on these sites. |
| Developed Lands - Roads | Joes Pond, Newark Pond, Bald Hill Pond | • Assist municipalities in updating Road Erosion inventories (REI) and prioritizing and implementing roads projects to meet the Municipal Roads General Permit (MRGP).<br>• Pilot a GIS road segmentation and private REI to identify, prioritize, develop, and implement private road restoration projects.<br>• Complete projects to address erosion issues on Class 4 roads and legal trails.<br>• Host a road forum to debrief towns on the flood response and provide some information to better support them in the next flood.<br>• Follow up on the meeting with one-on-one support to towns to prepare for the next flood |
| Wastewater | St Johnsbury, Danville, Lyndon, Joes Pond and Newark Pond watersheds, Concord and East St Johnsbury | • Encourage and support refurbishment and upgrade projects to public wastewater treatment facilities to help remove nitrogen from discharges<br>• Provide technical and financial support to the town of St Johnsbury to implement the long-term control plan to address CSOs to the Sleepers and Passumpsic Rivers.<br>• Educate onsite septic owners about septic system maintenance and alternative systems through local outreach and education programs such as Wastewater Workshops. |

| | Focus Areas | Priority Strategies |
|---|---|---|
| Rivers | East and West Branches Passumpsic, Millers Run, Water Andric, Lyndon, Sleepers | • Develop priority protection and restoration projects identified in Stream Geomorphic Assessments (SGAs), River Corridor Plans (RCPs), or culvert inventories.<br>• Continue buffer plantings and floodplain restoration efforts along rivers in priority locations.<br>• Pilot the identification, design, and implementation of low tech, process-based restoration projects.<br>• Identify, develop and implement strategic wood addition projects on large private landownerships.<br>• Increase conservation organization capacity to develop and implement river focused strategies in the Passumpsic River watershed.<br>• Develop public-facing communications on the importance of co-existing with rivers, including information on the benefits of river corridor protection and floodplain restoration projects.<br>• Provide technical support for communities to identify and implement floodplain restoration and flood resiliance projects including actions that come out of the Lyndon flood mitigation study.<br>• Develop designs and implement dam and USGS weir removal projects.<br>• Provide outreach to towns and assist them in adopting new FEMA flood maps or joining the NFIP program.<br>• Coordinate with regional partners to develop increased capacity to support towns in strengthening and implementing flood hazard and river corridor bylaws. |
| Lakes | Joes Pond, Coles Pond, Bald Hill Pond, Center Pond, Newark Pond. | • Support Lake Watershed Action Plans for priority lakes if there is sufficient community engagement to make assessments successful.<br>• Support Lake Wise assessments on priority lakes if sufficient opportunity for community engagement.<br>• Develop, design, and implement priority projects identified through Lake Wise assessments |
| Wetlands | Basin wide | • Scope and develop small-scale (10 – 50-acre) wetland protection and restoration opportunities.<br>• Evaluate opportunities to incorporate adjacent wetlands into the footprints of existing and new river corridor easements |
| Forests | State lands, town forests, and large private lands with significant tributary networks | • Pilot forest road inventories and implement priority projects on state, municipal, and potentially private lands.<br>• Identify and implement feasible forest erosion projects identified with emerging forest erosion mapping tools.<br>• Support the use of skidder bridges through rental and incentive programs.<br>• Encourage land conservation and Use Value Appraisal enrollment where landowners are interested and especially in drinking water source protection areas. |

The 2019 Passumpsic basin plan identified 43 strategies to address protection and restoration of surface waters. Of the 43 strategies identified, 6 are complete, 30 are ongoing or in progress, and 7 are awaiting action (Figure 1). The Passumpsic basin report card is available online on the Passumpsic Basin Webpage, and includes a list of detailed updates for each strategy identified in the 2019 Plan. Several strategies will be carried over to this plan.

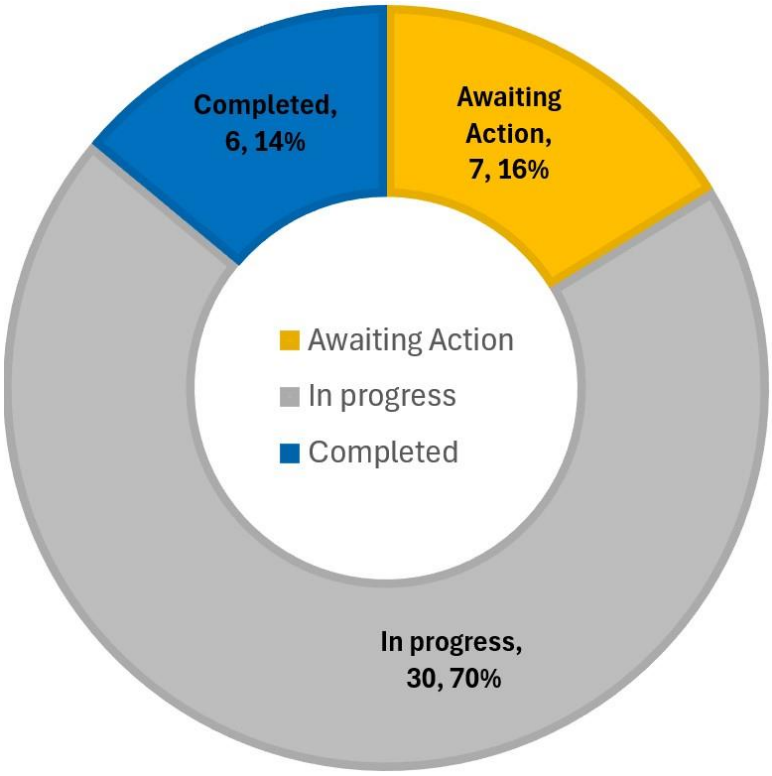



**Figure 1. Status of strategies from the 2019 TBP.**

The 42 priority strategies identified in this plan reflect input from the public, state and federal water quality staff, sector-based workgroups, watershed groups, and regional planning commissions. During the basin planning process, stakeholders expressed that unified clean water messaging, technical support and training on how to protect and maintain surface waters, and continued financial and technical support, are all critical to meet water quality goals. There was also a growing recognition of the overlap of clean water, habitat, and flood resilience goals and an understanding that well-sited natural resource protection and restoration actions can complement more traditional infrastructure-based strategies for improving local and basin-wide flood resilience. The importance of ensuring access to waters for all members of the community was identified including increasing community recognition of water resources and water quality challenges in this basin and was to address these challenges.

# What is a Tactical Basin Plan?

A Tactical Basin Plan (TBP) is a strategic guidebook produced by the Vermont Agency of Natural Resources (ANR) to protect and restore Vermont's surface waters. The agency develops these watershed plans for each of the 15 major basins in the State of Vermont. TBPs target strategies and prioritize resources to those actions that will have the greatest influence on surface water protection or restoration.


**Figure 2. Policy requirements of Tactical Basin Planning.**


**Figure 3. Five-year basin planning cycle.**

TBPs are integral to meeting a broad array of both state and federal requirements including the U.S Environmental Protection Agency's 9-element framework for watershed plans (Environmental Protection Agency, 2008), US Clean Water Act Section 303(e) for state-level water quality planning, and state statutory obligations including those of the Vermont Clean Water Act, and 10 VSA § 925 and 10 VSA § 1253 (Figure 2).

Tactical basin planning is carried out by the Water Investment Division in collaboration with the Watershed Management Division and in coordination with other state agencies and watershed partners. A successful basin planning process depends on a broad base of partnerships with other state, federal, regional, and local government agencies, and other stakeholders, including community and non-profit groups and academic institutions. The partnerships support and strengthen the Agency's programs by proposing new ideas and input, increasing understanding of water quality issues, and building commitment to implementing solutions.

Basin-specific water quality goals, objectives, strategies, and projects described in this Plan aim to protect public health and safety ensure public use and enjoyment of Vermont waters and their ecological health as set forward in the Vermont Surface Water Management Strategy and the

Vermont Water Quality Standards. The TBP process shown in Figure 3, allows for the issuance of plans for Vermont's 15 basins every five years.

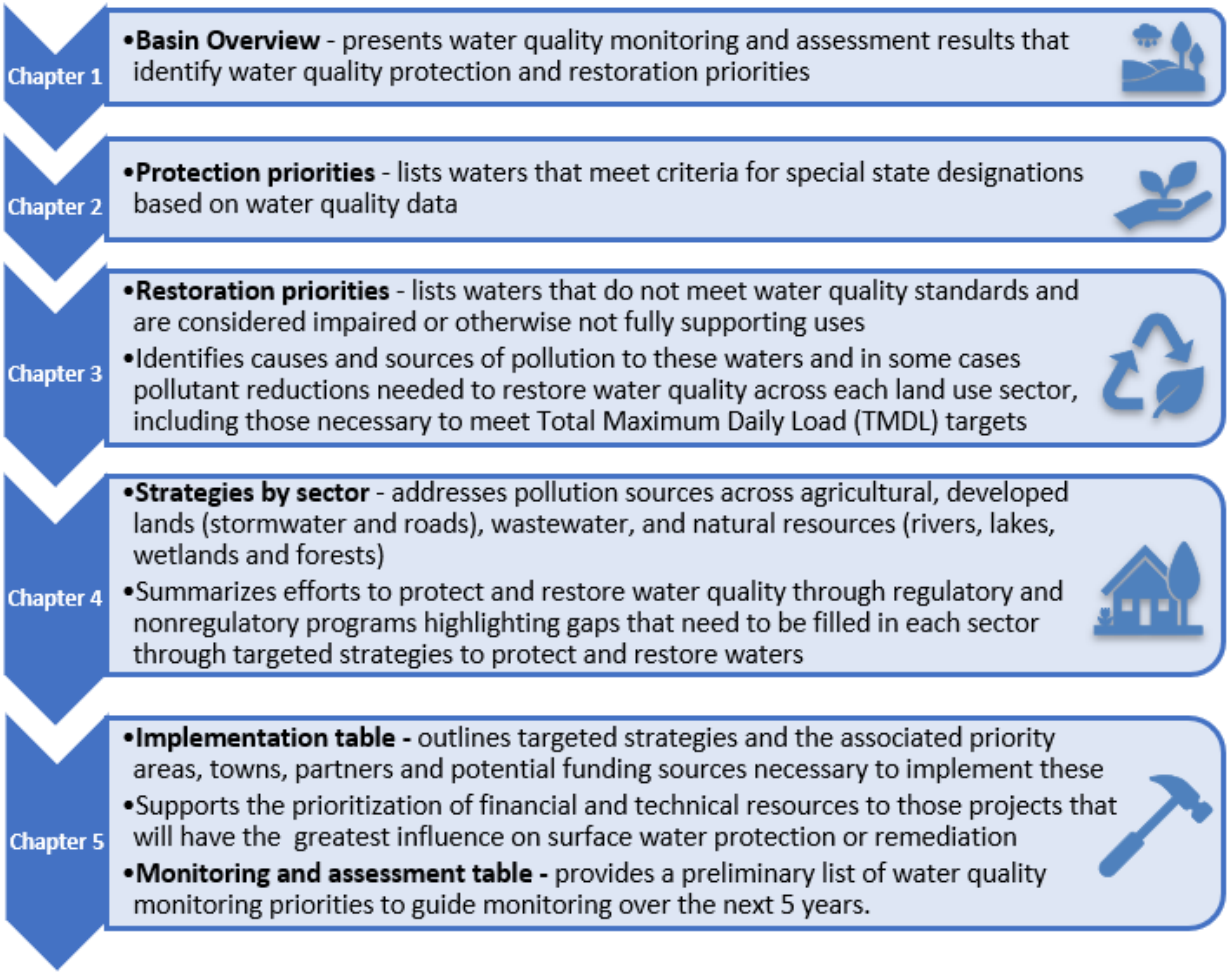



**Figure 4. Chapters of Tactical Basin Plans.**

Chapters 1 through 4 in the TBP describe water quality in the Basin, protection and restoration priorities, and efforts to protect and restore water quality for each sector. This information supports the targeted strategies listed in the implementation table in Chapter 5 (Figure 4).

Tactical Basin Plans identify strategies that help ANR, and its partners, prioritize activities for the next five years. These strategies inform individual projects that are identified and tracked in the Watershed Projects Database and the Watershed Projects Explorer. The Project Database and Explorer are found on ANR's Clean Water Portal and are continuously updated to capture project information throughout the TBP process.

# Chapter 1 – Basin Description and Conditions

## A. Basin Overview

The Passumpsic River watershed (Basin 15) encompasses 507 square miles, a major portion of Caledonia County and minor portions of Essex, Orleans and Washington counties. The East Branch of the Passumpsic River originates in the town of Brighton and joins the West Branch just northeast of Lyndonville. The Passumpsic River then joins Millers Run which drains the towns of Sheffield and Wheelock and flows over 20 miles to the south until it reaches the Connecticut River in East

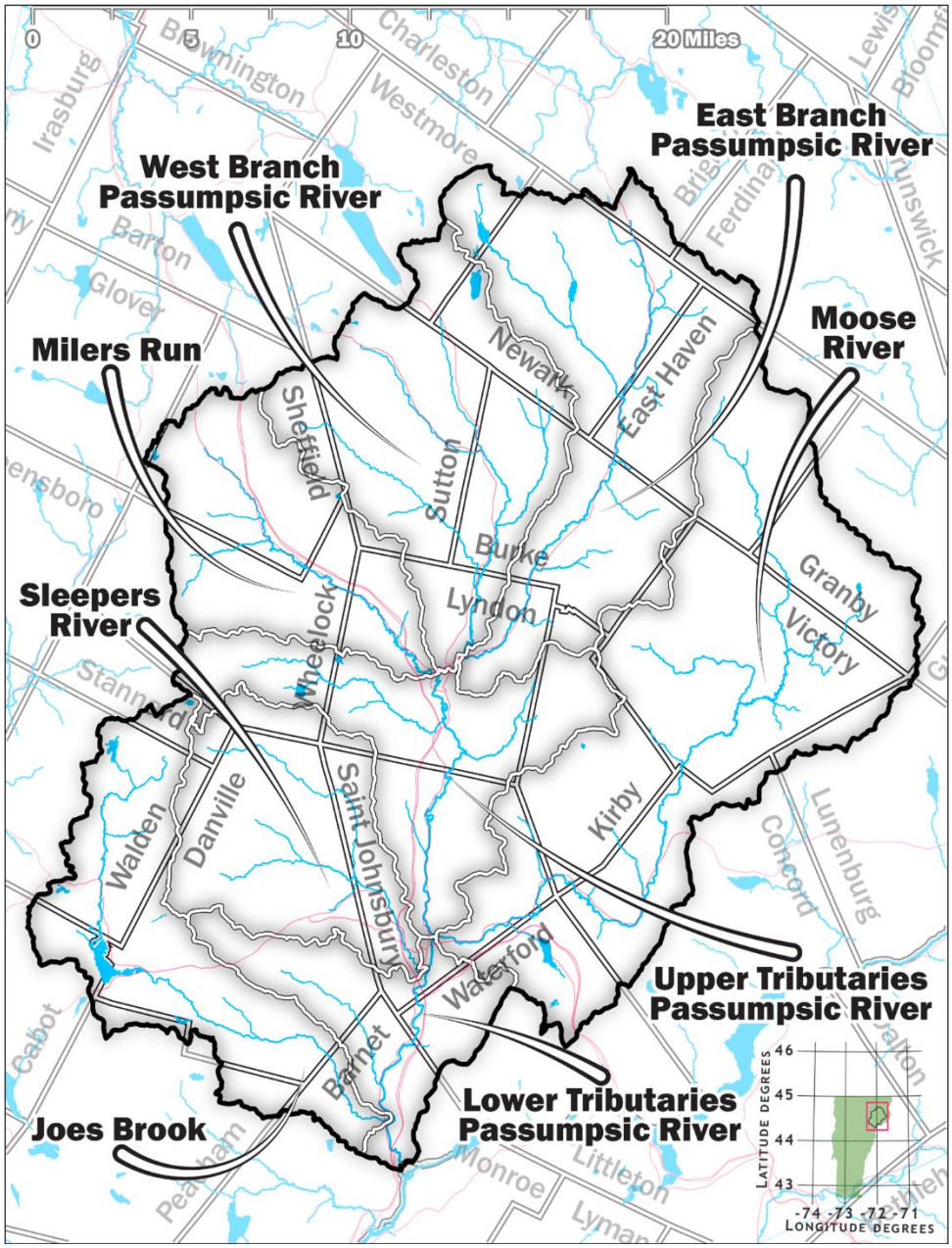



**Figure 5. The Passumpsic River Basin is composed of 8 sub-watersheds.**

Barnet passing over a series of seven hydroelectric dams along the way. The basin also includes the Moose River watershed with headwaters in East Haven and includes Victory Bog wetlands complex, along with the Sleepers River and Joes Brooks and several smaller tributaries which are broken out into lower and upper tributaries for this basin plan. A more extensive basin description is available in the Basin 15 Assessment Report (DEC, 2023) and The Passumpsic Watershed - Water Quality Assessment Report 2018 (VDEC, 2019).

## Land Use and Land Cover

The Passumpsic Basin is a predominantly forested landscape. Forested land covers about 77% of the Basin while about 5% is wetlands and open water. Developed and agricultural land cover about 6% and 8% of the Basin, respectively (Figure 6). A basin-wide analysis of land use change from 2001 to 2019 showed some changes in land cover over this time including increases in developed lands (2025 acres) and shrub scrub (4112 acres) and decreases in forest (-5132 acres), Herbaceous (-1250) and pasture and hay (-306 acres). Developed land increases were greatest in the central portion of the Passumpsic basin (Upper Passumpsic Tributaries) with an increase of over 400 acres along with an increase of 1150 acres of shrub scrub. This is balanced with a reduction in forest lands of over 1500 acres, and pasture of nearly 100 acres.

Land cover and land use are primary determinants of surface water quality. Large areas of properly managed forests, riparian buffers, and wetlands are principally responsible for good water quality in Vermont. Significant conversion from natural lands to developed or agricultural lands will likely contribute to increased nutrient levels in surface waters. However, where good management practices and quality local stewardship exist on agricultural and developed lands, good water quality can too.

## Climate Change Implications for Water Resource Management

Vermont is experiencing climate-related events each year as was witnessed in the July 2023 and 2024 events, and these events are projected to increase in frequency, complexity, and severity. It is imperative that Vermont and Vermonters adapt to threats posed by climate change now and build resilience for the storms that we will inevitably face in coming decades. Of the many natural hazards that impact Vermont, flooding poses the greatest risk to Vermont infrastructure and communities as described in the Vermont Climate Action Plan.

Adapting how we manage and use our surface waters in the face of climate change is one of the chief overarching challenges for basin planning. Climate is defined by long-term weather patterns, which in turn influence human and natural systems. In Vermont, climate change is causing increases in storm intensity and total precipitation (Betts, 2011) (National Oceanic and Atmospheric Administration, 2013). These increases will likely lead to a rise in flooding, water quality and ecosystem impairments, and reduced water-based recreational availability to Vermonters (Pealer & Dunnington, 2011).

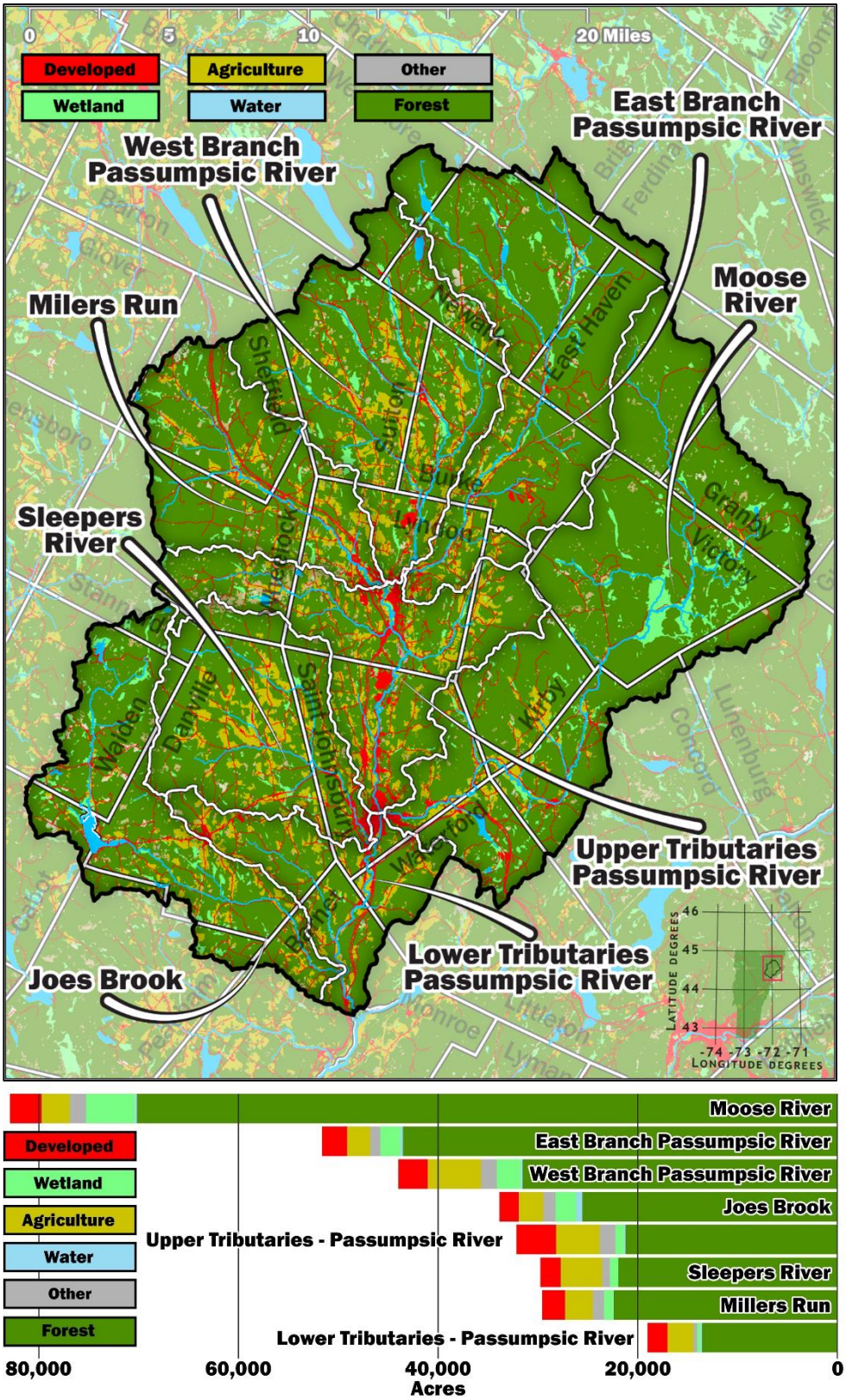



Figure 6. Land cover by acreage across Passumpsic basin sub-watersheds.

The 2021 Vermont Climate Assessment established state-level climate change information with implications for local surface waters. Vermont's average annual temperature has increased by almost 2°F (1.11°C) since 1900 with warming occurring twice as fast in winter (Galford, 2021). The latter results in earlier thaw dates for rivers, lakes and ponds, and mountain snowpack. Common fish species such as trout and salmon, and warm-water fish like smallmouth bass rely on groundwater discharges for cooler refuges during summer seasons. These refugia will decrease in availability as groundwater temperature is expected to increase over time. Fish are heavily reliant on their physical landscape and connectivity to migrate, move through different environments at different life stages, and take advantage of multiple habitat types. Infrastructure such as roads and dams have severely hampered the mobility of aquatic species and form barriers to fish migrating or seeking cold refuge during hot spells.

The 2021 Vermont Climate Assessment suggests extreme weather events such as droughts and floods are expected to continue to increase with climate change. Vermont experiences 2.4 more days of heavy precipitation than in the 1960s, typically in summer. Average annual stream flows are increasing, which is expected to continue in the future. High flows now happen more frequently, leading to increased inundation flooding and fluvial erosion (stream-related erosion) all of which can be exacerbated or alleviated by land-use management decisions. Aquatic habitats affected by increased runoff and streamflow could experience increases in sediment mobilization, nutrients and scouring in addition to increased water temperature. In response, local freshwater plant and animal species may shift their geographic ranges and alter their abundance and seasonal activities (Stamp J, 2020).

The Vermont Climate Assessment highlights five key messages for water resources in Vermont:

- Due to extreme variation in precipitation with our changing climate, periods of prolonged dry-spells and drought, coupled with higher water usage in snowmaking and agriculture could exacerbate low water availability.

- Increases in overall precipitation, and extreme precipitation, have caused average annual streamflows to rise since 1960. Climate change will further this pattern, although the overall increase in streamflow comes with disruptions in seasonal flows cycles.

- Increases in heavy precipitation jeopardize water quality in Vermont. Storms produce large runoff events that contribute to erosion and nutrient loading. Combined with warm temperatures, this creates favorable conditions for cyanobacteria blooms.

- Increased occurrence of high streamflows increases the risk of flooding that causes damage to many roads and crossing structures. Risk reduction requires addressing outdated and unfit structures.

- Nature-based solutions are an effective, low-cost approach to climate change adaptation. River corridor, floodplain, and wetland protection dampen flood impacts and improve water quality along with green infrastructure.

Protective measures, such as strategic land acquisition and limitations on development in riparian areas, may be the most economical solution to address the challenges presented by climate change and to achieve healthy surface waters (Watson, Ricketts, Galford, Polasky, & O'Niel-Dunne, 2016) (Weiskel, 2007). But where pollution from historic and current land use occurs, strategies are identified in this plan that will complement protective measures, such as river corridor easements, riparian area plantings, floodplain and wetland restoration, dam removals, and agriculture, forestry, and stormwater best management practices. Ongoing efforts to strengthen ecological resilience and the role of natural infrastructure in protecting built communities can be found on the Climate Change in Vermont website. This website also details the 2020 Global Warming Solutions Act (Act 153), which sets Vermont greenhouse gas emissions reduction goals, establishes a Climate Council tasked with developing and updating a Climate Action Plan (2021 Initial Vermont Climate Action Plan), and requires the Agency of Natural Resources to adopt rules consistent with the plan.

## Summer 2023 and 2024 Flooding

In July 2023 and 2024, flooding events occurred across Vermont, and several towns in the Passumpsic River Basin sustained significant damage. In 2023, intense runoff events impacted localized areas of the basin and in 2024 the July 11th and 30th events together significantly impacted most areas of the basin. The July 11th, 2024, storm event caused flooding on major tributaries in the basin inundating in downtown Lyndon and along Memorial Drive in St Johnsbury and causing flood damage across the basin. The impacts from this event have resulted in a major disaster declaration.

The July 30th, 2024, event was more localized with eight inches of rain over just 6 hours in St Johnsbury, heavily impacting small to moderate sized streams and causing miles of roads and driveways to washout, the failure of countless culverts, damage to wastewater collection systems, impacts to private property and causing many small drainages to transform into large gullies overnight. Similar amounts of rain in Kirby and Lyndon caused catastrophic damage along Red Village and Brook roads and surrounding areas and communities were significantly impacted. The impacts from this event have also resulted in a major disaster declaration. Many of the strategies in this plan will serve to increase flood resiliency of basin communities by supporting improved stormwater treatment and road best management practices, supporting municipal flood response, removing obsolete dams and upgrading undersized culvert upgrades, through the implementation of low-tech process-based restoration techniques, and increased communication and support for communities to implement flood hazard regulations.

In response to the 2023 flooding and numerous previous flooding events, the Vermont legislature passed Act 143 in 2024 relating to natural disaster government response, recovery, and resiliency.

The Act creates the Community Resilience and Disaster Mitigation Grant Program for the purpose of awarding grants for municipal disaster mitigation projects. These grants will provide funding for:

> (A) technical assistance for natural disaster mitigation, adaptation, or repair to municipalities;
>
> (B) technical assistance for the improvement of municipal stormwater systems and other municipal infrastructure;
>
> (C) projects that implement disaster mitigation measures, adaptation, or repair, including watershed restoration and similar activities that directly reduce risks to communities, lives, public collections of historic value, and property; and
>
> (D) projects to adopt and meet the State's model flood hazard bylaws.

Additionally, the legislature also passed Act 121 relating to the regulation of wetlands, river corridor development, and dam safety. This act requires the development of a State River Corridor Base Map to identify areas suitable for development located in existing settlements in river corridors that will not contribute to fluvial erosion hazards, establish minimum flood hazard area standards, protect, regulate, and restore wetlands so that the State achieves a net gain of wetlands acreage, and enables the Dam Safety Revolving Loan Fund to provide financial assistance for emergency and nonemergency dam projects.

Further recommendations to increase flood resiliency across Vermont include:

- Seek to make permanent the Flood Resilient Communities Fund (FRCF) that was created through an ARPA funding allocation in 2021 and has been a successful flood mitigation program. Additionally, evaluate expanding eligibilities for the FRCF program to maximize the impact of federal hazard mitigation funding and coordinate flood resilience work at the statewide level across state agencies.
- Consider additional conservation practices and incentives for agricultural lands that are located in river corridors and low-lying floodplains that often provide ecosystem services in major flood events.
- Increase funding for private property buyouts and slope stability mitigation to protect public health and safety and build longer term flood resilience.

## B. Water Quality Conditions

The Vermont Water Quality Standards (VWQS) provide the basis used by the Vermont Department of Environmental Conservation (DEC) in determining the condition of surface waters including whether the water meets or does not meet certain criteria. The assessment of a water's condition within the context of the VWQS requires consideration of the water's classification, designated and existing uses, and the corresponding narrative and numeric water quality criteria (see Chapter 2 for

definitions). This assessment categorizes Vermont's surface waters as either "full support, altered, or impaired".

DEC uses a five-year rotational monitoring approach, where basin sites are typically monitored once every five years. This state-collected data is augmented by community-science monitoring programs throughout the state, including the LaRosa Partnership Program and the Lay Monitoring Program. Water quality monitoring and assessment work is described in detail in the Watershed Management Division's Water Quality Monitoring Program Strategy and the 2022/2023 Water Quality Biomonitoring and Assessment Report.

Most surface water monitoring is led by programs in DEC's Watershed Management Division (WSMD), including the Rivers Program, the Lakes and Ponds Management and Protection Program (LPMPP), and the Wetlands Program The result of this work offers site specific assessments of the Basin's waters.

Within the Rivers Program, the Biomonitoring and Aquatic Studies Section focuses on biological monitoring of aquatic macroinvertebrate and fish communities, plus targeted water chemistry and temperature monitoring. Biomonitoring staff also support the LaRosa Partnership Program, a community-based nutrient and chloride monitoring program. See the LaRosa Partnership Program's Power BI interface and database reports to interact with data collected through this program. The Burke Conservation Commission and Connecticut River Conservancy have sampled streams in the Passumpsic River watershed though the LaRosa Partnership Program. The Rivers Program also supports stream geomorphic assessments that evaluate geomorphic and physical habitat conditions of rivers, and the Streamflow Protection Section administers a cooperative agreement with the U.S. Geological Survey to maintain and operate a number of stream gages in Vermont.

The Lakes and Ponds Management and Protection Program supports the Inland Lake Assessment and Lay Monitoring Programs, which evaluate nutrient conditions and trends on lakes, as well as shoreland condition and more in-depth lake assessments through the Spring Phosphorus Program and Next Generation Lake Assessments. The LPMPP also performs surveys to monitor the spread of aquatic invasive species in Vermont's public waters through the Vermont Aquatic Invasive Species Program.

Jointly, the Rivers Program and Lakes and Ponds Management and Protection Program maintain a network of twelve stream and 13 lake sentinel sites statewide respectively, which are monitored every year for biology, temperature, water chemistry and hydrology (at a subset of sites). These sentinel sites have negligible prospects for development or land use change and are closely monitored to isolate long term impacts related to climate change. Two of these lakes (Stannard Pond and Bald Hill Pond, and two stream sites (Bog Brook and the Moose River at mile 25.7) are in the Passumpsic Basin.

The Wetlands Program conducts biological assessments on the wetland health and the functions and values of wetlands.

In addition to the WSMD's surface water monitoring programs in this basin, the following programs also contribute monitoring data to determine the health of Vermont's surface waters:

- The Vermont Fish and Wildlife Department conducts fisheries assessments and targeted temperature monitoring to assess the health of recreational fish populations and opportunities for habitat restoration.
- The Vermont Agency of Agriculture, Food, and Markets conducts monitoring at sampling sites throughout Vermont on rivers and tributaries that pass through agricultural use areas. The Agency also runs the Ambient Surface Water Study to establish baseline levels of pollutants and to monitor for the presence of neonicotinoids, glyphosate, corn herbicides, and nitrate in Lake Champlain and its contributing tributaries.
- The Drinking and Groundwater Protection Division and the Watershed Management Division monitor Per- and Polyfluoroalkyl Substances.

Tactical Basin Plans include monitoring information reported by Vermont State agencies as results relate to the designated uses defined by the VWQS. Most of the DEC monitoring data can be accessed through the Vermont Integrated Watershed Information System online data portal.

The following is an overview of water resource health in the Passumpsic basin. More detail is provided in the Basin 15 - Passumpsic River Basin Assessment Report published in 2023 (DEC, 2023) and in Chapters 2 and 3. Chapter 2 includes waters where values and uses exceed current classifications, while Chapter 3 includes waters on the Vermont Priority Waters List, the list of rivers and lakes that do not meet VWQS or other Agency criteria.

## Rivers and Streams

### *Biological Assessment*

Biological communities reflect overall ecological integrity (i.e., chemical, physical, and biological condition). Therefore, biomonitoring results can directly assess the status of a waterbody relative to the primary goal of the federal Clean Water Act. These communities integrate the effects of different stressors and thus provide a broad measure of the stressors' aggregate impact. Because they integrate stressors over time, they can provide an ecological measure of fluctuating environmental conditions. The WSMD uses biological monitoring (i.e., biomonitoring) to detect aquatic biota impairments in wadeable streams, as well as the type and severity of potential stressors causing the impairment. Biomonitoring is also important for identifying streams at or near a reference level condition. Each community of macroinvertebrates and fish is rated from *Poor* (severely degraded and not meeting VWQS) to *Excellent* (similar to the natural condition and exceeding the VWQS). If a stream

repeatedly fails to meet minimum aquatic biota expectations, it is a candidate for the Vermont Priority Waters List. If a stream has macroinvertebrate and fish communities consistently at or near a reference level condition, it is a candidate for increased protection through upward reclassification.

Macroinvertebrate and fish monitoring is conducted following procedures outlined in the WSMD Field Methods Manual (DEC 2022). Applying biocriteria and determining assessments for both communities is outlined in the VWQS (2022).

## Macroinvertebrate Monitoring Results

Macroinvertebrate assessments were completed at 54 sites in the Passumpsic basin between 2012 and 2022 (Figure 7, Table 2). The results of the assessments are described below. In addition, to ensure a comprehensive understanding of water quality basin wide, a gap analysis was conducted by DEC to identify sites without current monitoring data (Figure 8). Some of these will be prioritized based on land use or other factors for the 2025 monitoring season and can be found in the Chapter 5 Monitoring and Assessment Table.

Of the 54 completed macroinvertebrate sites assessed, 35 monitoring sites (65%) exhibited *Very Good* or better condition in their most recent assessment. Of these, 18 were found to be *Excellent*, meaning their macroinvertebrate community is comparable to reference or natural condition. Most of these waters are either headwater streams or located higher up in the watershed. Another 17 were found to be in *Very Good* to *Very Good - Excellent* condition. Streams in *Very Good* or better condition exceed the VWQS criteria for B(2) classification and are priorities for additional assessment and protection. Seventeen (31%) macroinvertebrate assessments scored *Good* or *Good - Very Good*. These streams meet the VWQS B(2) criteria and are priorities for maintenance and protection. Two sites (4%) scored *Fair* or lower, failing to meet VWQS B(2) criteria.

## Fish Monitoring Results

Fish community assessments were completed at 35 sites between 2011 and 2022 in the Passumpsic basin (Figure 7, Table 2). Based on the most recent sample event at these sites, seven of the sample sites had only Brook Trout, which means that a community assessment could not be made; however, a density criterion can be applied for upward reclassification of Brook Trout only streams. Another three sites were unable to be assessed. Of the 25 sites where fish communities could be assessed, 22 (88%) had fish communities in *Excellent* or *Very Good* condition, indicating the fish communities at these sites exceed the VWQS for class B(2) streams. One site with fish assessments exhibited a community in *Good* condition, which meet the VWQS for class B(2) streams and are priorities for maintenance and protection.

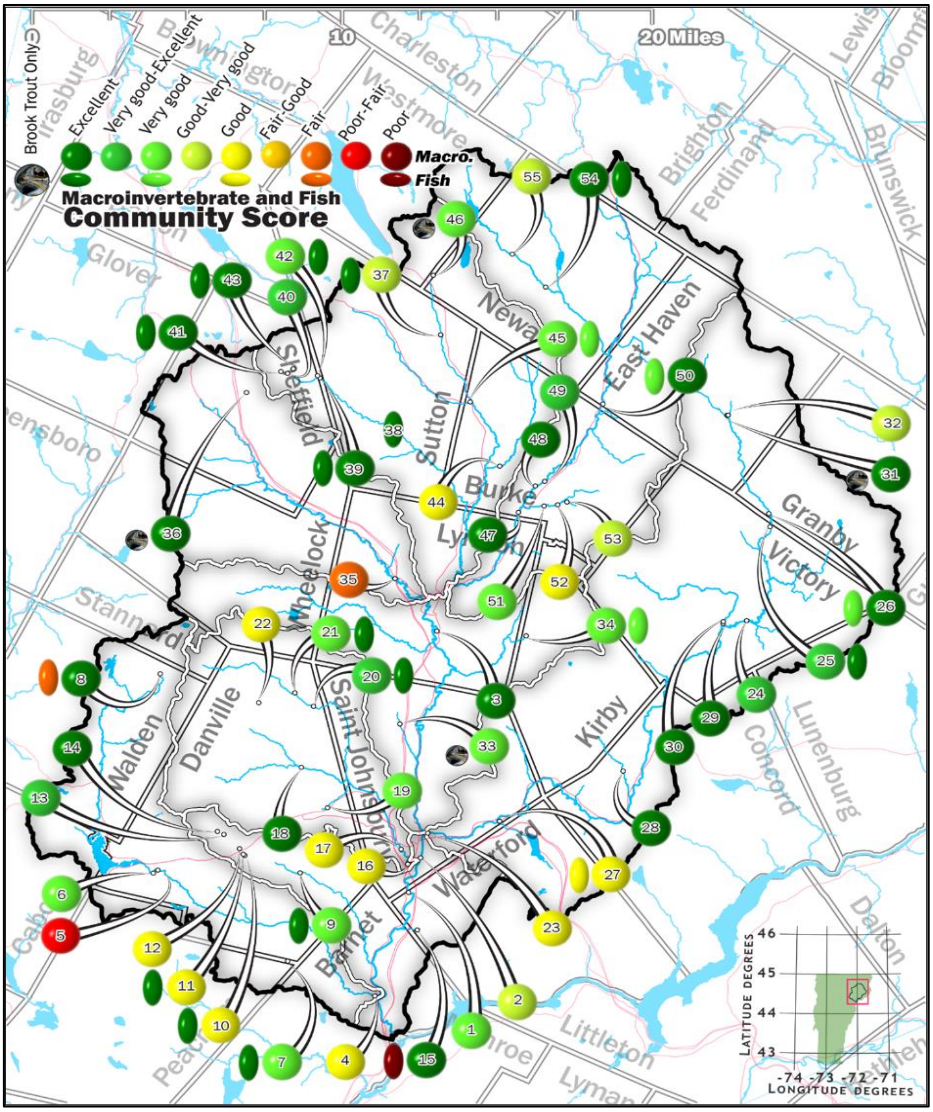



**Figure 7. Biological condition of fish and macroinvertebrate communities of the Passumpsic basin sampled since 2012. Map IDs correspond with data in Table 12 in the Basin Assessment Report.**

Two sites (8%) with fish assessments exhibited communities in *Fair* or *Poor* condition. At both of these sites the *Fair* or *Poor* fish-based conditions were in contrast with *Excellent* macroinvertebrate-based conditions. Often, a fish community can suggest different stressors from a macroinvertebrate community; therefore, assessing both the macroinvertebrate and fish community at a site is useful when resources allow it. Sites that fail to pass VWQS for a single community but score well for the other may be prioritized for further sampling to determine if anthropogenic impacts are responsible for the degradation. These sites are included in the Chapter 5 Monitoring Table (Table 12).

**Table 2. Bioassessment results in the Passumpsic basin assessed between 2012 and 2022. Map ID corresponds to assessed sites in biological condition map above. For each site, only the most recent assessment result is given. 'BKT' indicates a brook trout only fish community. U= Unable to assess.**

| Map ID | Site Name, River Mile | Macroinvertebrate Year | Macroinvertebrate Assessment | Fish Year | Fish Assessment |
|---|---|---|---|---|---|
| 1 | Passumpsic River, 6.7 | 2022 | Very Good | | |
| 2 | Passumpsic River, 8.6 | 2020 | Good - Very Good | | |
| 3 | Passumpsic River, 18.3 | 2020 | Excellent | | |
| 4 | Joes Brook, 0.5 | 2020 | Good | | |
| 5 | Joes Brook, 10.5 | 2012 | Poor - Fair | | |
| 6 | Joes Brook, 10.8 | 2020 | Very Good | | |
| 7 | Rake Factory Brook, 2.3 | 2022 | Very Good | 2022 | Excellent |
| 8 | Steam Mill Brook, 5.5 | 2015 | Excellent | 2015 | Fair |
| 9 | Water Andric, 4.3 | 2020 | Fair | 2020 | Very Good |
| 10 | Water Andric, 6.5 | 2020 | Very Good | 2020 | Excellent |
| 11 | Water Andric, 6.6 | 2020 | Good | 2012 | Excellent |
| 12 | Water Andric, 6.9 | 2017 | Good | | |
| 13 | Water Andric, 7.6 | 2017 | Very Good | | |
| 14 | Water Andric, 7.8 | 2017 | Excellent | 2017 | BKT |
| 15 | Simpson Brook, 0.5 | 2020 | Excellent | 2020 | Poor |
| 16 | Sleepers River, 0.4 | 2015 | Good | | |
| 17 | Sleepers River, 1.3 | 2015 | Good | 2015 | Very Good |
| 18 | Sleepers River, 6.8 | 2020 | Excellent | | |
| 19 | Roy Brook, 1.3 | 2012 | Very Good | | |
| 20 | Houghton Brook, 0.8 | 2020 | Very Good - Excellent | 2020 | Excellent |
| 21 | Houghton Brook, 1.6 | 2015 | Very Good | 2015 | Excellent |
| 22 | North Brook, 2.6 | 2015 | Good | 2015 | BKT |
| 23 | Moose River, 0.1 | 2022 | Good | | |
| 24 | Moose River, 20.6 | 2020 | Very Good - Excellent | 2020 | U |
| 25 | Moose River, 25.7 | 2022 | Very Good - Excellent | 2021 | Excellent |
| 26 | Moose River, 26.8 | 2012 | Excellent | 2012 | Very Good |
| 27 | Stiles Brook, 0.1 | 2021 | Good | 2022 | Good |
| 28 | Kirby Brook, 1.1 | 2021 | Excellent | 2021 | U |
| 29 | Bog Brook, 0.1 | 2015 | Excellent | | |
| 30 | Bog Brook, 0.2 | 2022 | Excellent | 2022 | U |
| 31 | West Branch Moose River, 0.1 | 2022 | Excellent | 2017 | BKT |
| 32 | East Branch Moose River, 0.1 | 2022 | Good - Very Good | 2019 | BKT |
| 33 | Stark Brook, 1.5 | 2015 | Good - Very Good | 2015 | BKT |
| 34 | Barnes Brook, 0.1 | 2015 | Very Good | 2015 | Very Good |
| 35 | Millers Run, 2.6 | 2020 | Fair | | |

| Map ID | Site Name, River Mile | Macroinvertebrate Year | Macroinvertebrate Assessment | Fish Year | Fish Assessment |
|---|---|---|---|---|---|
| 36 | Nation Brook Trib 3, 0.8 | 2013 | Excellent | 2013 | BKT |
| 37 | West Branch Passumpsic River, 17.6 | 2019 | Good – Very Good | 2019 | Excellent |
| 38 | Calendar Brook, 5.3 | | | 2016 | Excellent |
| 39 | Calendar Brook, 9.8 | 2020 | Excellent | 2020 | Excellent |
| 40 | Calendar Brook, 11.2 | 2012 | Very Good | | |
| 41 | Calendar Brook, 11.4 | 2013 | Excellent | 2017 | Excellent |
| 42 | Clark Brook, 0.2 | 2013 | Very Good | 2013 | Excellent |
| 43 | Calendar Brook Trib 22, 0.4 | 2013 | Excellent | 2013 | Excellent |
| 44 | Roundy Brook, 0.5 | 2020 | Good | | |
| 45 | Sutton River, 0.1 | 2020 | Very Good | 2020 | Very Good |
| 46 | Arcadia Brook, 0.3 | 2015 | Very Good | 2015 | BKT |
| 47 | East Branch Passumpsic River, 3.8 | 2015 | Excellent | | |
| 48 | East Branch Passumpsic River, 5.3 | 2022 | Excellent | | |
| 49 | East Branch Passumpsic River, 5.7 | 2022 | Very Good - Excellent | | |
| 50 | East Branch Passumpsic River, 8.9 | 2015 | Excellent | 2015 | Very Good |
| 51 | Dish Mill Brook, 0.8 | 2020 | Very Good | 2020 | Excellent |
| 52 | Dish Mill Brook, 1.3 | 2015 | Good | 2015 | Excellent |
| 53 | Dish Mill Brook Trib 2, 0.2 | 2015 | Good – Very Good | 2015 | Excellent |
| 54 | Bean Brook, 3.1 | 2020 | Excellent | 2020 | Excellent |
| 55 | Bean Brook, 4.8 | 2020 | Good – Very Good | | |

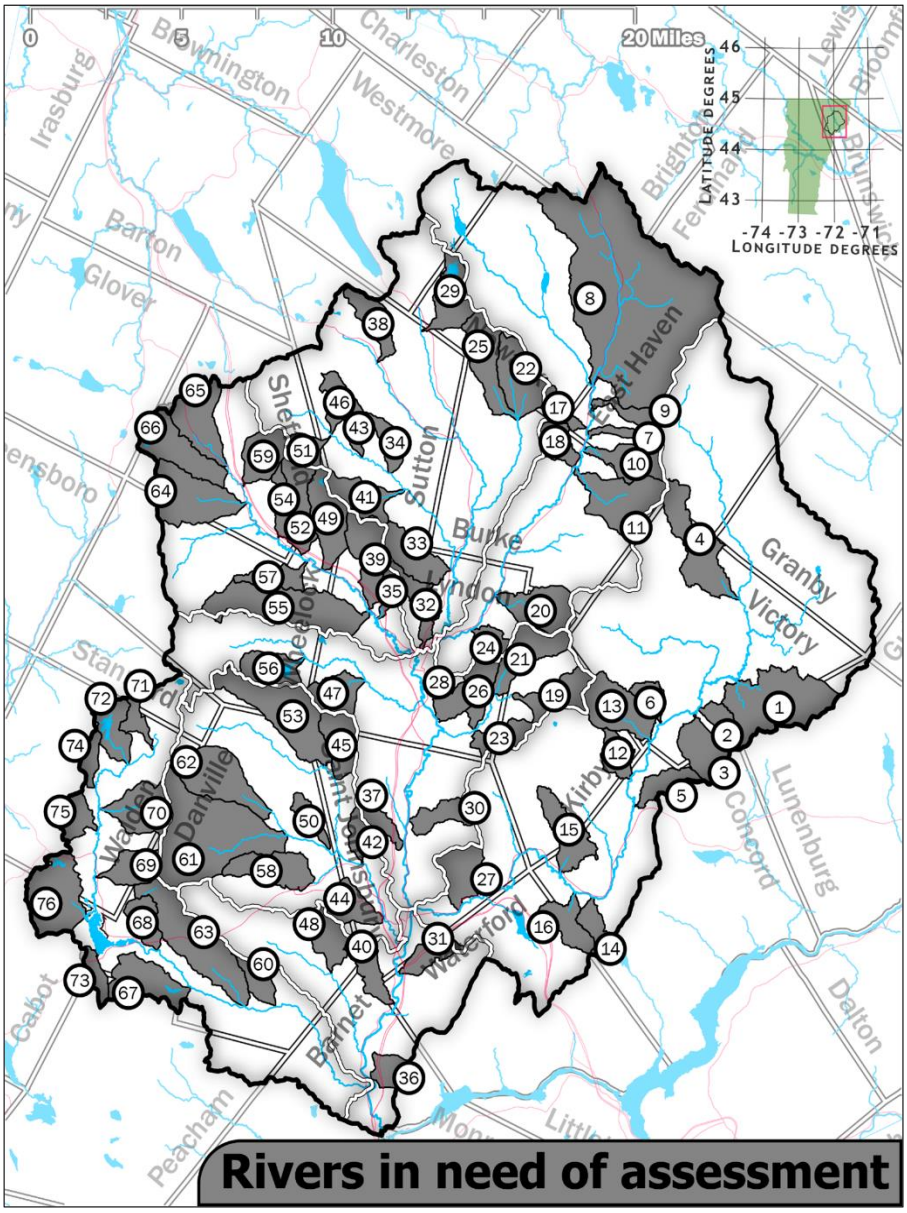



**Figure 8. Stream catchments without biosurvey data in the Passumpsic basin. Sites are listed in the Chapter 5 Monitoring Table (Table 12).**

## *Stream Geomorphic Assessment*

Fluvial geomorphology is a subdiscipline of geomorphology that investigates how flowing water shapes and modifies Earth's surface through erosional and depositional processes. The Rivers Program conducts a three-phase approach to assess the physical condition of rivers in the State of Vermont. Phase 1 is a watershed assessment. Phase 2 is a rapid field stream assessment, and Phase 3 is a survey assessment.

Most of the stream reaches with Phase 2 Assessments have been rated as good to fair condition (Figure 9). Most larger tributaries in the Passumpsic that are not heavily impacted by dams have been subject to Phase 2 Assessments; therefore, the fair geomorphic conditions noted by Phase 2-assessed reaches are likely representative of basin conditions. No Assessments have been completed in the basin since the 2019 TBP.

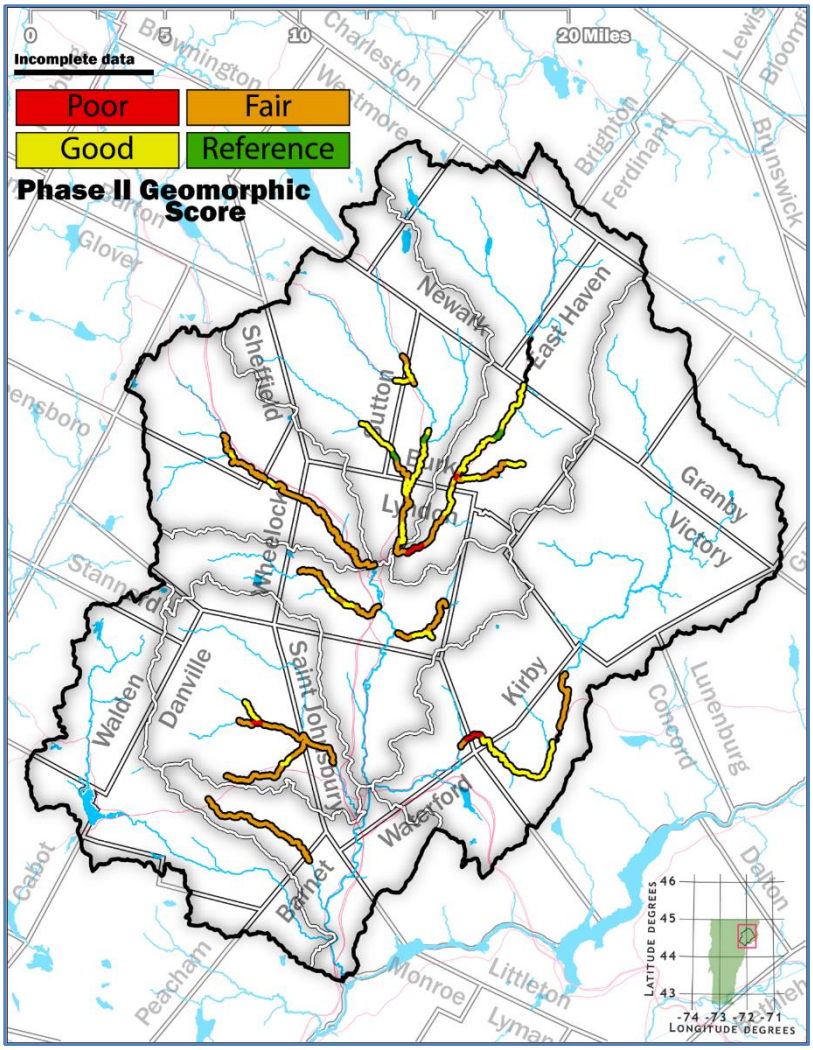



**Figure 9. Geomorphic condition of assessed Passumpsic basin rivers and streams.**

## *PFAS Monitoring*

Per- and polyfluoroalkyl substances (PFAS) are a large group of human-made chemicals that have been used in industry and consumer products worldwide since the 1950s. PFAS chemicals from household and commercial products may find their way into water, soil, and biosolids. As a result, PFAS have been found in people, fish, and wildlife all over the world. Some PFAS do not break down easily and therefore stay in the environment for a very long time, especially in water.

The DEC is working with the Vermont Department of Health to identify sources and reduce the use and release of and public exposure to PFAS. The 2023 PFAS Road Map and 2019 PFAS Sampling Plan outlines strategic priorities relating to PFAS and summarizes the actions taken by DEC to address PFAS in Vermont. Major actions include adopting drinking water and groundwater PFAS standards; developing a plan to derive ambient surface water quality standards; adopting Solid Waste Rules that require PFAS testing for biosolids and sites where biosolids are applied; responding to PFAS contamination in multiple sites; and developing a statewide investigation of the potential major sources of PFAS including wastewater treatment facilities, publicly owned treatment works, industrial sources, land application sites, and landfills. To this end, wastewater-specific PFAS sampling and source prioritization information is available in Chapter 4 – Wastewater.

### *Chloride Monitoring*

Chloride is a naturally occurring element in the environment but usually occurs in relatively small amounts in Vermont surface waters. Most sources of chloride result from human activities including deicing agents (road salt), agriculture (animal waste), dust suppression, human waste (septic systems and wastewater treatment) and water softeners. In most areas, road salt is believed to be the most significant contributor of chloride to the environment in Vermont.

For the protection of aquatic biota, the VWQS have chloride specific criteria for both acute and chronic exposures that were recommended to states by the US Environmental Protection Agency in 1988. There is also evidence that negative impacts occur below the VWQS criteria concentrations. Macroinvertebrate community health in Vermont streams appears to be negatively impacted at chloride levels as low as 50 mg/l. The Environmental Protection Agency is currently in the process of reviewing more recent toxicity studies regarding chloride impacts to aquatic biota, but any future recommendations to revise the VWQS are still several years away. More information on the WSMD approach to chloride monitoring and reduction is available in the 2022-2023 Water Quality Monitoring and Assessment Report.

## Lakes and Ponds

There are just 20 lakes and ponds in the Basin that are ten acres or greater which is one of the fewest numbers of lakes of any basin in the state. Of the five lakes in the Basin over 100 acres, only Joes Pond dam is managed by hydroelectric facility and Stiles Pond is managed as the water supply for the town of St Johnsbury. More information on dam location, status, purpose, and ownership can be found in Appendix A.

## *Lake Scorecard Assessment*

The Vermont Lakes and Ponds Management and Protection Program shares lake assessments using the Vermont Inland Lakes Scorecard (Figures 10 and 11, Table 3). The scorecard provides available data on overall lake health by providing a rating of a waterbody's nutrient trend, shoreland and lake habitat, atmospheric pollution, and aquatic invasive species. The Lake Scorecard's rating system is detailed here. Lake-specific water quality and chemistry data can be accessed online through the Lay

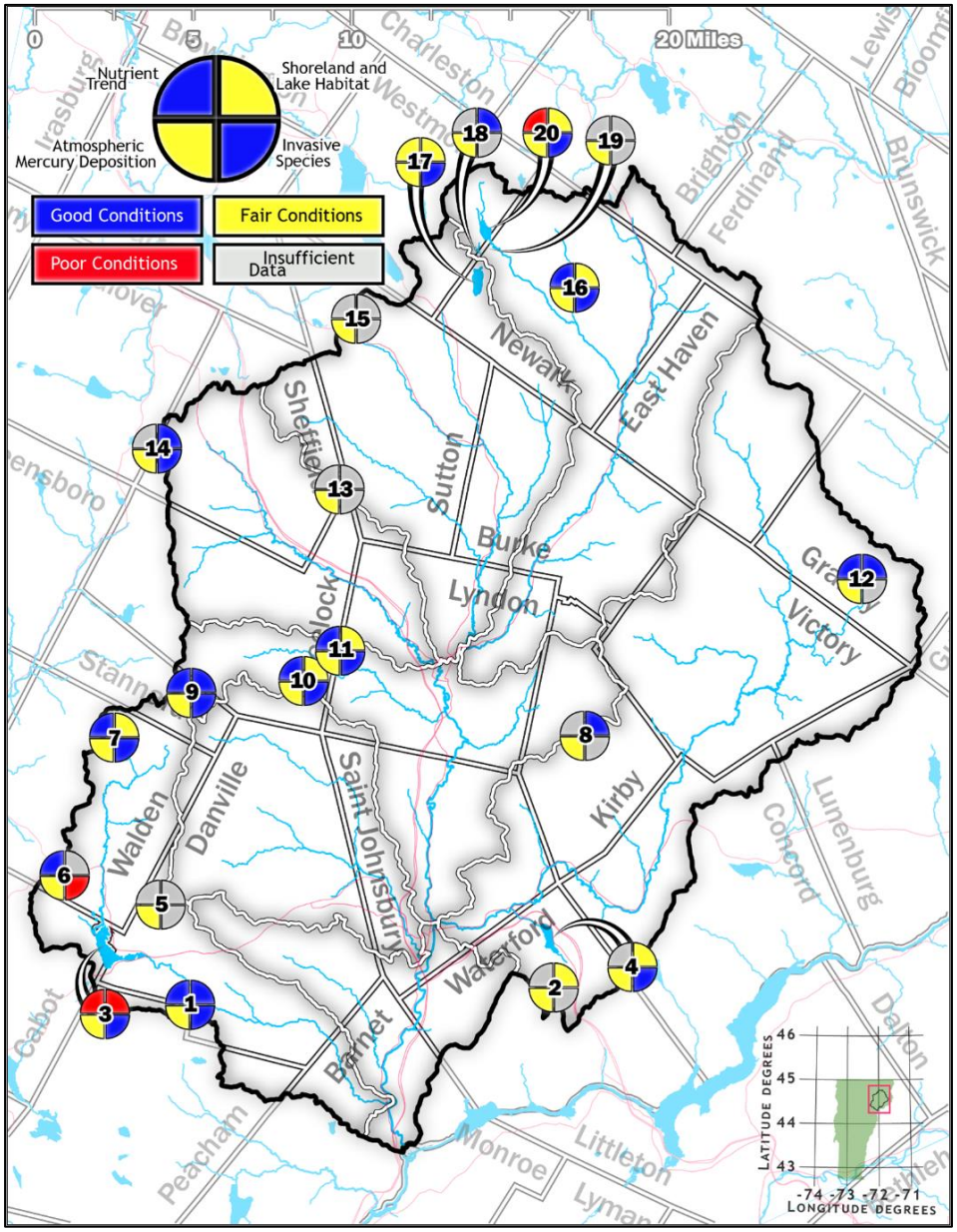



**Figure 10. Condition of Passumpsic basin lakes and ponds.**

Monitoring Program webpage. Passumpsic basin Lake Scorecard results are summarized below for lakes larger than 10 acres.

Of the 15 lakes evaluated for shoreland condition in the basin, six have *Good* ratings, one has a *Poor* rating (Joes Pond), and eight have a *Fair* rating. Of the eleven lakes monitored for nutrient water quality trends, two lakes (Joes Pond and Bald Hill) have a *Poor* rating, while Newark Pond scored as *Fair*. Spring phosphorus levels are highly significantly increasing in Joes Pond and Bald Hill, while summer phosphorus is significantly increasing in Newark Pond.

Beyond nutrient impairment, Vermont has acid- impaired waterbodies, although none of these are in the Passumpsic Basin. Three main airborne pollution types affect lakes and ponds in Vermont: sulfur oxides, nitrogen oxides, and mercury. These pollutants are attributable to the prevailing weather pattern that carries mid-west air pollution through the region, the proximity to those pollution sources and to the lack of buffering capacity of the bedrock geology.

Sulfur and nitrogen oxides transported to Vermont from out of state air emissions results in acid forming pollutants raising in-lake acid concentrations. Lakes and ponds are regularly monitored for low pH (high acidity), which impacts biological communities. Thirty-nine lakes and ponds are included in the Vermont Acid Impaired Lake Total Maximum Daily Load. Since the USEPA began enforcing the Clean Air Act and its amendments, nationwide emissions and deposition of acid forming pollutants have declined. As a result, Vermont's in-lake acid concentrations have improved. More information about long term monitoring of Vermont's acid lakes can be found at: https://dec.vermont.gov/watershed/map/monitor/acid-rain

Mercury contamination has resulted in fish consumption advisories in nearly every lake in Vermont. Mercury is an atmospherically deposited contaminant, which arrives in Vermont primarily as a result of coal burning emissions, or solid waste incineration. Much has been accomplished in recent years to control emissions nationally, yet this remains a long-term issue. Atmospherically deposited mercury is transferred up the food chain from plankton to fish, loons, and larger birds and mammals. All lakes in the Basin received a fair condition score for mercury.

Out of the 11 lakes greater than 10 acres that have been surveyed for aquatic invasive species only Lyford Pond has a *Poor* rating. A poor score indicates that there is at least one invasive species present, regardless of its abundance or 'nuisance' level.

**Table 3. Passumpsic basin Lake Scorecard ratings for lakes greater than ten acres. 'ID' = Insufficient data.**

| Map ID | Lake ID | Area (ac) | Depth (ft) | Nutrient Trend | Shoreland Condition | Aquatic Invasive Species | Atmospheric Mercury Deposition |
|---|---|---|---|---|---|---|---|
| 1 | Keiser | 34.6 | 20 | Good | Good | Good | Fair |
| 2 | Duck (Waterford) | 20.1 | 2 | ID | Fair | ID | Fair |

| Map ID | Lake ID | Area (ac) | Depth (ft) | Nutrient Trend | Shoreland Condition | Aquatic Invasive Species | Atmospheric Mercury Deposition |
|---|---|---|---|---|---|---|---|
| 3 | Joes (Danville) | 405.0 | 78 | Poor | Poor | ID | Fair |
| 4 | Stiles | 154.8 | 33 | ID | Fair | Good | Fair |
| 5 | Upper Danville | 10.4 | | ID | ID | ID | Fair |
| 6 | Lyford | 36.2 | 22 | Good | ID | Poor | Fair |
| 7 | Coles | 106.8 | 21 | Good | Fair | Good | Fair |
| 8 | Kirby | 10.7 | 2 | ID | Good | ID | Fair |
| 9 | Stannard | 23.8 | 11 | Good | Good | Good | Fair |
| 10 | Chandler | 66.8 | 6 | Good | Fair | Good | Fair |
| 11 | Bean (Lyndon) | 26.1 | 15 | Good | Fair | Good | Fair |
| 12 | Mud (Granby) | 23.4 | 2 | Good | Good | ID | Fair |
| 13 | Mathewson | 14.0 | | ID | ID | ID | Fair |
| 14 | Bruce | 27.1 | 13 | ID | Good | Good | Fair |
| 15 | Marl | 10.2 | | ID | ID | ID | Fair |
| 16 | Center | 81.3 | 72 | Good | Fair | Good | Fair |
| 17 | Newark | 158.2 | 31 | Fair | Fair | Good | Fair |
| 18 | Brown | 15.8 | 2 | ID | Good | ID | Fair |
| 19 | Sawdust | 14.7 | | ID | ID | ID | Fair |
| 20 | Bald Hill | 108.6 | 42 | Poor | Fair | Good | Fair |

## Wetlands

The Vermont Wetlands Program houses the Wetland Bioassessment Program which assesses the biological condition and ecological integrity of Vermont wetlands. Plant species are used as the primary biological indicator to assess wetland health. Based on a 2017 analysis of bioassessment data, the principal factors that correlate with poor wetland condition are:

- presence of invasive plant species,
- disturbance to the wetland buffer or immediate surrounding area,
- disturbance to wetland soils, and
- disturbance to wetland hydrology (how water moves through a wetland) through ditching (e.g., agricultural), filling (e.g., roads) and draining (e.g., culverts).

Wetlands in remote areas and at high elevations tend to be in good condition, with the most threatened wetlands occurring in areas of heavy agricultural use and high development pressure often exhibiting habitat loss.

## *Wetland Bioassessment and Vermont Rapid Assessment Method*

A total of 30 wetlands in the Basin have been assessed using the Vermont Rapid Assessment Method (VRAM; Figure 12). The VRAM assigns each wetland a score ranging from 15 to 100 with higher numbers representing more intact ecological condition and higher levels of wetland functions and values. The highest scoring wetlands are in the upper Joes Pond watershed. Note that the VRAM assessments in this watershed may not necessarily be representative of the Basin's wetlands, as random sampling was not conducted and a full inventory of all the wetlands in the Basin is not possible at this time.

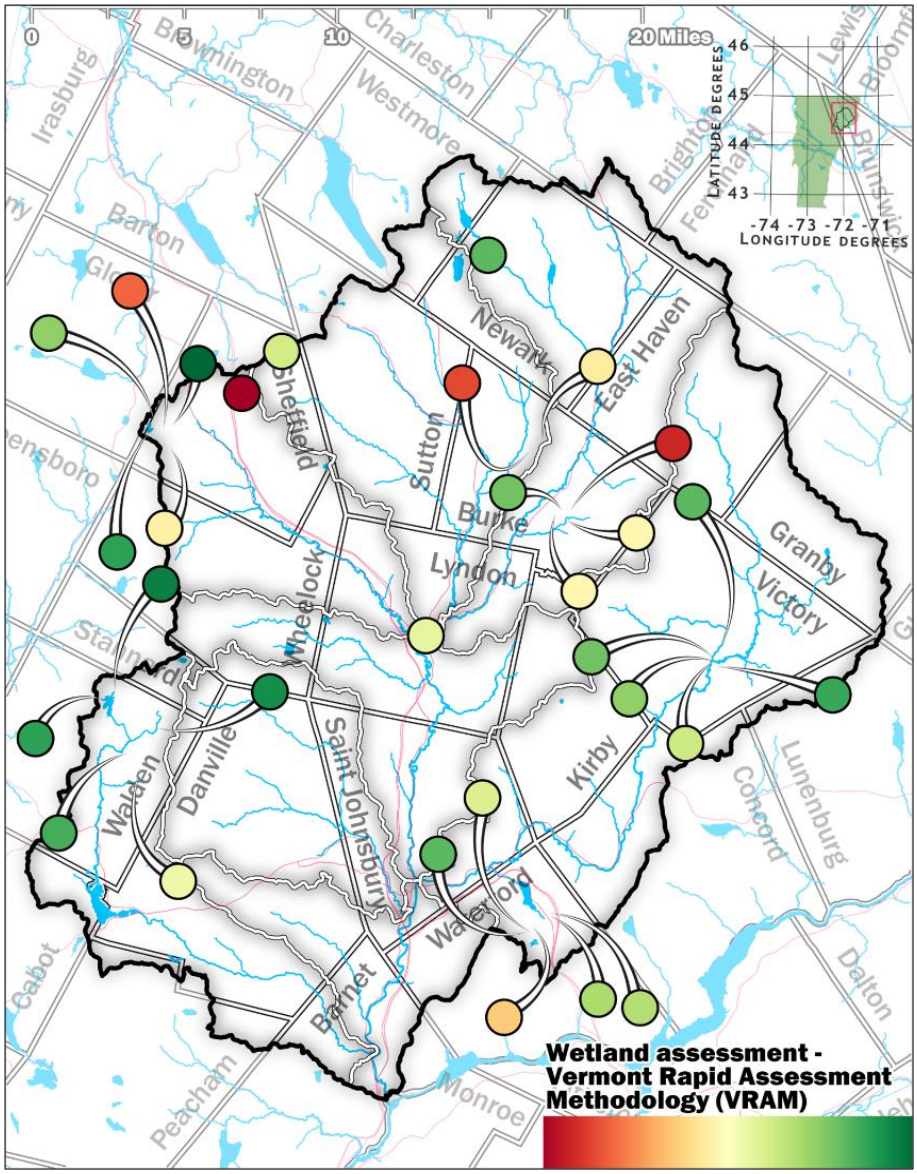



**Figure 11. Completed Wetland VRAM assessments. Green indicates better wetland condition and red indicates poorer condition.**

# Chapter 2 – Priority Areas for Surface Water Protection

The state protects lakes, wetlands, and rivers by establishing and supporting surface water management goals. Tactical Basin Plans (TBPs) identify surface waters that consistently attain a higher level of quality and value based on physical, chemical, and biological criteria. These waters are prioritized for reclassification or designation. This allows for the establishment of enhanced management objectives and supports implementation of strategies to protect these surface waters.

Additional pathways, such as land stewardship programs, local protection efforts, conservation easements, and land acquisition are also used to increase protection of priority waters. These are described in Chapter 4 - Strategies for Protection and Restoration. Two lakes and seven streams in this basin meet or exceed standards for very high-quality condition and are prioritized for reclassification.

## A. Surface Water Reclassification and Designation

Vermont's surface water classification system establishes management goals and supporting criteria for designated uses in four classes of water. Designated uses include aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating, swimming, public water supply, and irrigation. The VWQS begin classification with two broad groups based on elevation:

- All waters above 2,500 feet in elevation, are designated Class A(1) for all uses, unless specifically designated Class A(2) for use as a public water source.
- All waters at or below 2,500 feet in elevation, are designated Class B(2) for all uses, unless specifically designated as Class A(1), A(2), or B(1) for any one or more uses.

Current classifications of surface waters and their uses are published in the VWQS and are identified through the tactical basin planning process or on a case-by-case basis. Table 4 lists the possible classes for each designated use.

**Table 4. Uses of Vermont waters by classification.**

| Classification | Applicable Uses |
|---|---|
| Class A(1) | One or more of: Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating, or swimming |
| Class A(2) | Public water source |
| Class B(1) | One or more of: Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, or boating |
| Class B(2) | Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating, swimming, public water source or irrigation |

Surface waters may be protected by the anti-degradation policy of the VWQS (DEC, 2022) or through one of the following pathways:

- Reclassification of surface waters
- Class I Wetland designation
- Outstanding Resource Waters designation

The tactical basin planning process includes the review of ANR monitoring and assessment data to identify and document surface waters that meet the criteria for a higher classification or designation. (10 V.S.A. § 1253).

Public involvement is an essential component of protecting river, wetland, and lake ecosystems. The VWQS indicate that in the basin planning process, "Public participation shall be sought to identify and inventory problems, solutions, high quality waters, existing uses and significant resources of high public interest." The public, watershed partners, and stakeholders are encouraged to make recommendations for additional monitoring and research where very high-quality waters may exist.

In addition, the public may petition the DEC to reclassify streams and lakes, and to designate Outstanding Resource Waters. DEC has developed procedures and documents for Class I wetland designations and draft documents for stream reclassification. When the public is involved in developing proposals regarding management objectives, the increased community awareness can lead to protection of uses and values by the community and individuals.

Further information on reclassification and the petition process can be found on the following WSMD webpages: Stream Reclassification, Lakes and Ponds Reclassification, and Class I Wetlands. Strategies for enhanced protection of waters are described in further detail in the following sections. Surface waters in need of supplemental monitoring to determine their potential for enhanced management are included in Chapter 5 in the Monitoring and Assessment Table.

## A(2) Public Water Sources

Six waters in the Passumpsic basin are designated as A(2) public water sources (Table 5). Stiles Pond is actively being used by the town of St Johnsbury, while the other five located in Lyndon and West Burke are no longer being used as a public water supply. A(2) waters that are no longer used as water supply are candidates for reclassification to A(1), B(1), or B(2) for better long-term management.

**Table 5. Current and abandoned Class A(2) public water sources.**

| Waters | Location | Water User | Status |
|---|---|---|---|
| Unnamed tributary to Miller Run including Mathewson Reservoir | Lyndonville | Village of Lyndonville water source. Unnamed tributary to Miller Run including Mathewson Reservoir and all waters within their watersheds above the intake in the Towns of | Abandoned. |

| Waters | Location | Water User | Status |
|---|---|---|---|
| | | Lyndon and Sutton. Recommend reclassification to B(1) or B(2). | |
| Unnamed tributary to Miller Run including Copeland Reservoir | Lyndonville | Village of Lyndonville water source. Unnamed tributary to Miller Run including Copeland Reservoir and all waters within their watersheds above the intakes. Recommend reclassification to B(1) or B(2). | Abandoned. |
| Chandler Pond | Lyndonville | Lyndonville Village water source. Chandler Pond and all waters within its watershed in the Town of Wheelock. Wheelock Pond drains to the South Wheelock Branch. Recommend reclassification to B(1) or B(2). | Abandoned. |
| Woodworth Reservoir | Lyndonville | Lyndonville water source. Woodworth Reservoir and all waters within its watershed in the Town of Lyndon. Woodworth Reservoir flows to the South Wheelock Branch. Recommend reclassification to B(1) or B(2). | Abandoned. |
| Two unnamed tributaries to Sutton River. | West Burke | Unknown water source. Two unnamed tributaries to the Sutton River, near West Burke, and all waters within their watersheds above the intakes. Recommend reclassification to B(1) or B(2). | Abandoned. |
| Stiles Pond | St. Johnsbury | St. Johnsbury Village (WSID 5045) water source. Stiles Pond and all waters within its watershed in the Town of Waterford. Stiles Pond is in the St. Johnsbury municipal forest and flows to the Moose River. | Active |

## A(1) & B(1) Waters for Aquatic Biota

Biomonitoring assessments by the WSMD identified eight surface waters as consistently and demonstrably attaining a higher level of quality than Class B(2) based on draft criteria for aquatic biota reclassification: six meeting Class B(1) and two meeting Class A(1) (Figure 12).

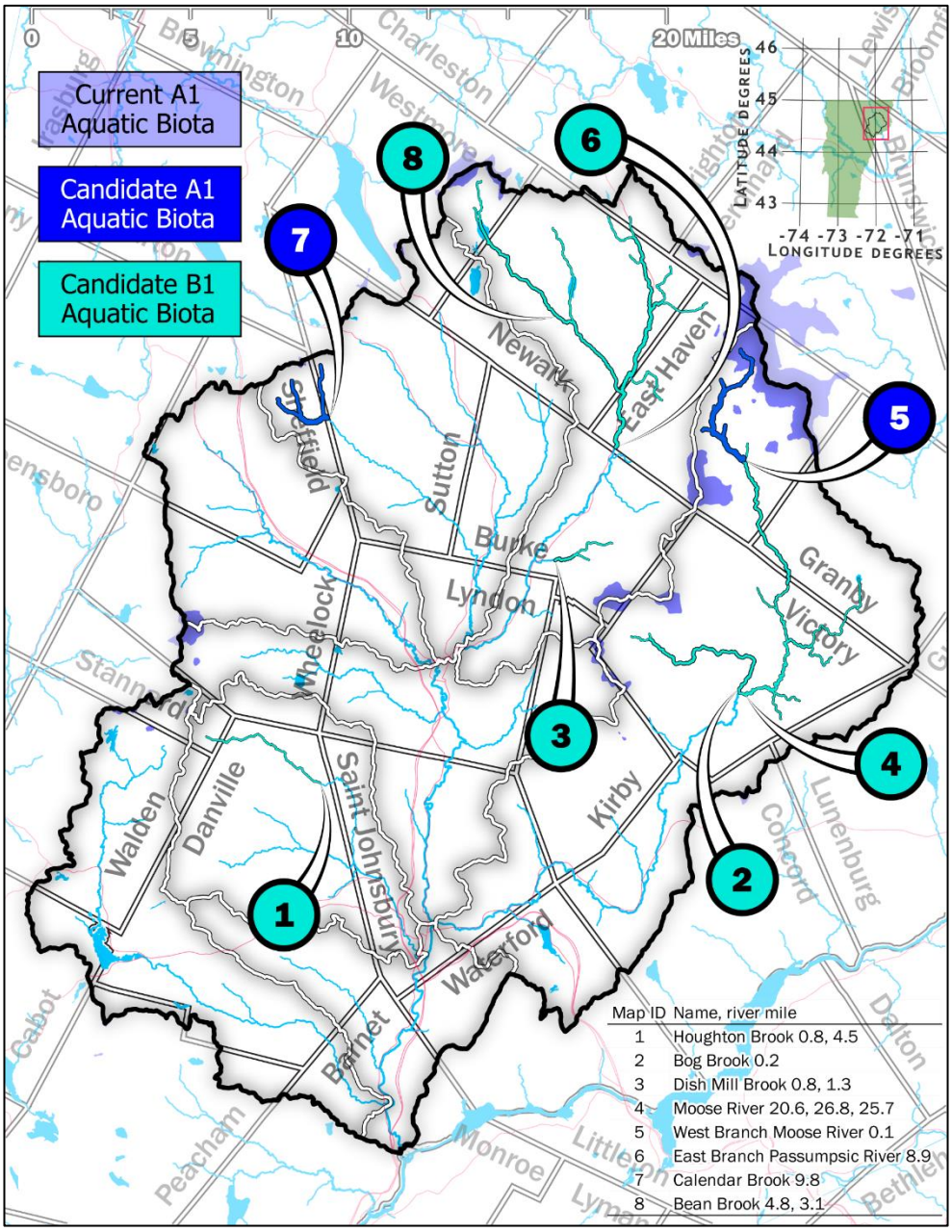



**Figure 12. Candidate stream reaches for reclassification based on criteria for aquatic biota use.**

## Waters In Need of Further Assessment

Ten rivers and streams need supplemental monitoring to determine their potential for enhanced protection (Figure 13). These waters are included in Chapter 5 in the Monitoring and Assessment Table.

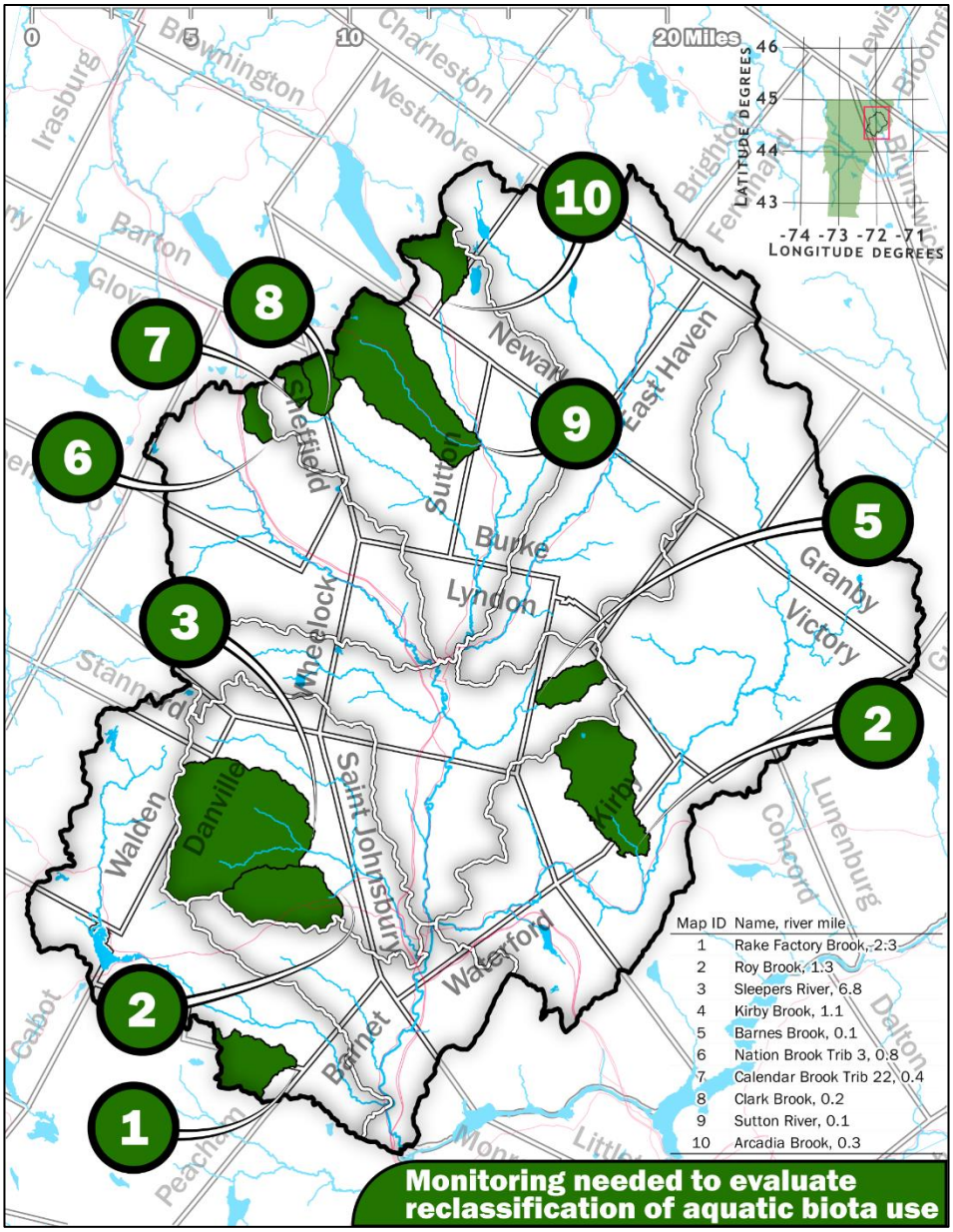



**Figure 13. Priority streams for additional assessment to determine eligibility for A(1) or B(1) reclassification for aquatic biota.**

## B(1) Waters for Recreational Fishing

Rivers and streams classified as B(1) recreational fishing waters support wild, self-sustaining salmonid populations characterized by the presence of multiple age classes and a minimum abundance of 1,000 individuals per mile (all species/ages/sizes); and/or 200 large (> 6 inches total length) individuals per mile; and/or 20 pounds/acre (all species/ages/sizes). Based on the currently available data there are no streams that meet B(1) criteria for recreational fishing (§29A-306 of the

VWQS) however there are 14 streams with data that suggests they may meet the B(1) criteria (Table 6), but additional data collection is necessary to support this determination. It is important to note that all waterbodies that would naturally support fish populations are protected and maintained for this use in perpetuity.

**Table 6. Streams that may meet B(1) criteria for recreational fishing with additional data collection.**

| Stream | Latitude | Longitude | Sub-basin | Town |
|---|---|---|---|---|
| **Water Andric** | 44.39336 | -72.06913 | Lower Tributaries | Danville |
| **Brown Brook** | 44.39303 | -72.14101 | Joes Brook | Danville |
| **Burroughs Brook** | 44.51883 | -72.09227 | Sleepers | Danville |
| **Dexter Brook** | 44.59842 | -72.10069 | Millers Run | Sheffield |
| **Dish Mill Brook** | 44.58972 | -71.92346 | East Branch | Burke |
| **Dolloff Inlet** | 44.70694 | -72.025 | West Branch | Sutton |
| **Hawkins Brook** | 44.51968 | -71.95185 | Lower Tributaries | Kirby |
| **Joes Brook trib** | 44.40865 | -72.18498 | Joes Brook | Danville |
| **Nation Brook Trib #3** | 44.64731 | -72.1261 | Calendar Brook | Sutton |
| **Morrill Brook** | 44.44703 | -72.14543 | Sleepers River | Danville |
| **Nation Brook** | 44.62948 | -72.13399 | Calendar Brook | Sutton |
| **Pope Brook** | 44.47974 | -72.14314 | Sleepers River | Danville |
| **South Wheelock Branch** | 44.54697 | -72.1209 | Upper Tributaries | Wheelock |
| **Umpire Brook** | 44.56451 | -71.8405 | Moose River | Victory |

## A(1) & B(1) Waters for Aesthetics

The VWQS include a designated use for aesthetic conditions. DEC has developed numeric nutrient criteria for lakes and ponds in relation to this use which are reflected in Table 3 of the VWQS. Two lakes currently meet the criteria for A(1) aesthetics given the available data including Coles Pond and Newark Pond, and four have been prioritized for additional monitoring to determine their A(1) eligibility: Center Pond, Bald Hill Pond, Keiser Hill Pond, and Marl Pond (Monitoring Table 12).

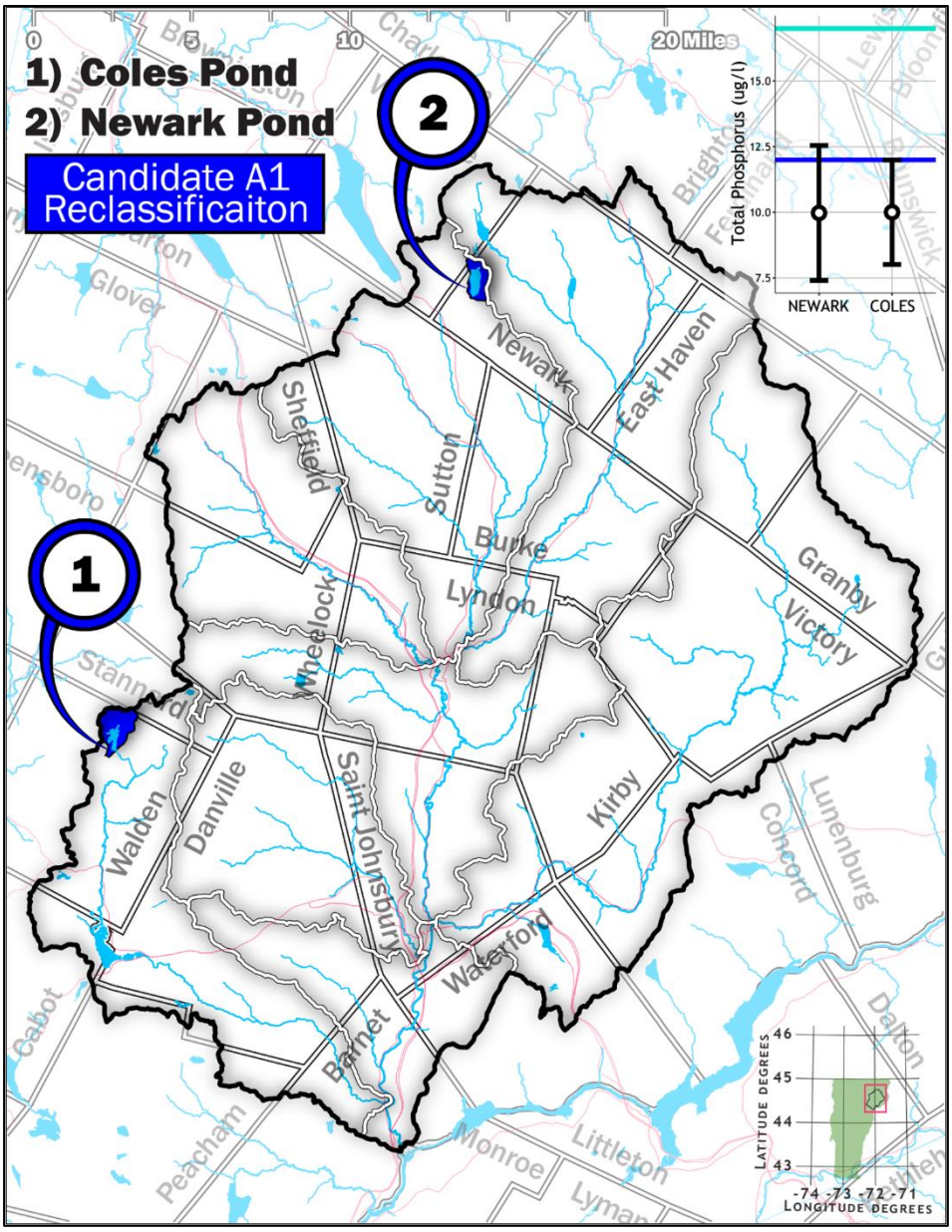



**Figure 14. Candidate lakes for reclassification based on criteria for aestetic use.**

## B. Class I Wetland Designation

The State of Vermont identifies and protects the functions and values of significant wetlands to achieve no net loss of wetlands. Based on an evaluation of the extent to which a wetland provides functions and values, it is classified as:

- **Class I**: Exceptional or irreplaceable in its contribution to Vermont's natural heritage and therefore, merits the highest level of protection.
- **Class II**: Merits protection, either taken alone or in conjunction with other wetlands.
- **Class III**: Neither a Class II nor a Class I wetland.

Impacts to Class I wetlands may only be permitted when the activity is necessary to meet a compelling public need for health or safety. The Wetlands Program Class I Wetlands website highlights the designated Class I wetlands statewide and lists those recommended for Class I designation.

There are no designated Class I wetlands in the Passumpsic River Basin. The Vermont Wetlands Program has also assessed Victory Bog since the 2018 TBP and has deemed it a candidate Class I wetland. (Figure 15).

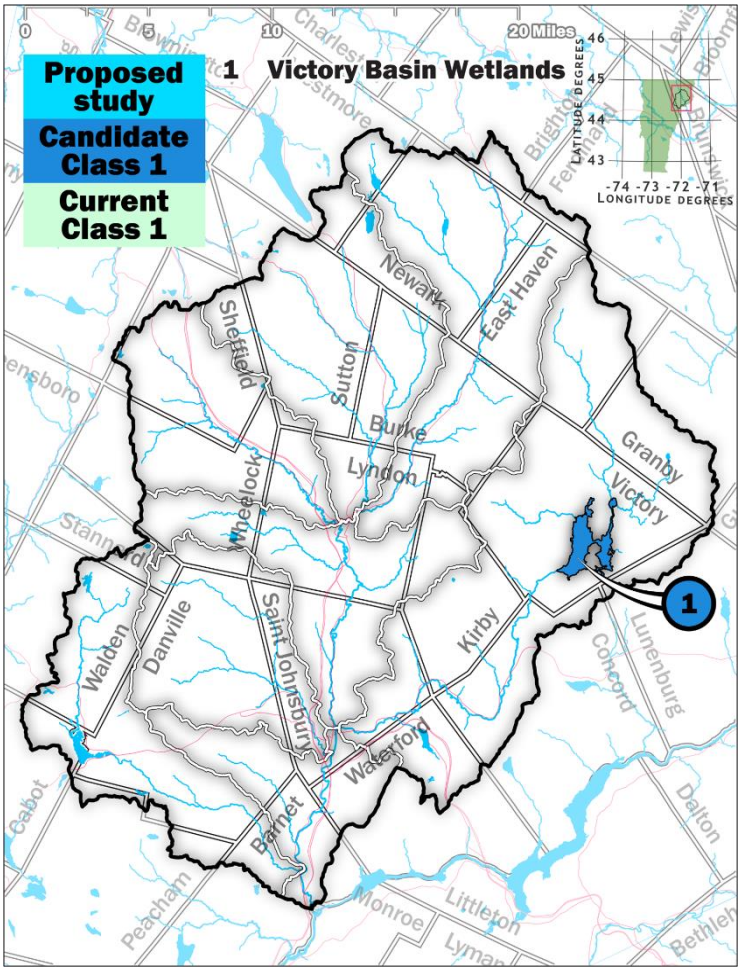



**Figure 15. Candidate Class I wetlands.**

DEC supports the further study and reclassification of wetlands and the Wetlands Program welcomes recommendations for Class I candidates. Wetlands that are found to meet criteria for designation may be proposed for reclassification through petition or departmental rulemaking authority, consistent with the Vermont Wetland Rules.

## C. Outstanding Resource Waters Designation

Rivers, streams, lakes, and ponds that have "exceptional natural, cultural, recreational, or scenic values" can be protected through designation as Outstanding Resource Waters (ORW). ORW designation protects exceptional waters through permit conditions for in-stream alterations, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250 projects, and other activities. ORWs can be designated by the ANR through a public petition process.

There are currently no ORW designations in the Passumpsic River Basin or recommendations in this plan for new ORW designations. ANR would support a community-led effort to petition the waters where petitioners can demonstrate the presence of ORW values.

## D. Identification of Existing Uses

Existing uses of waters and the level of water quality necessary to protect those existing uses shall be maintained and protected regardless of the water's classification (DEC, 2022).

The ANR may identify existing uses of waters during the tactical basin planning process or on a case-by-case basis during application reviews for State or Federal permits. Consistent with the federal Clean Water Act, the VWQS stipulate that existing uses may be documented in any surface water location where that use has occurred since November 28, 1975. Pursuant to the definition of Class B(1) in Act 79, the ANR may identify an existing use as Class B(1) when that use is demonstrably and consistently attained.

The ANR stipulates that all lakes and ponds in the state have existing uses of swimming, boating, and fishing. The ANR recognizes that fishing activities in streams and rivers are widespread and too numerous to thoroughly document for the basin. In the case of streams too small to support significant fishing activity, the ANR recognizes these as potential spawning and nursery areas, which contribute fish stocks downstream where fishing may occur. These small streams support the use of fishing and therefore, are protected at a level commensurate with downstream areas.

Existing uses listed in the basin plan should be viewed as a partial accounting of known existing uses based upon limited information. The list does not change protection under the Clean Water Act or VWQS for unlisted waters. Existing uses are listed on the Passumpsic Tactical Basin Planning webpage and include swimming, boating, fishing, and public water sources. The public is encouraged to recommend waters for the existing uses of swimming, boating, fishing, public water source, and ecological significance given that they provide evidence of such use.

# Chapter 3 – Priority Areas for Surface Water Restoration

## A. Impaired and Altered Surface Waters

The DEC monitors and assesses the chemical, physical, and biological status of individual surface waters to determine if they meet the VWQS per the 2022 Vermont Surface Water Assessment and Listing Methodology (DEC, 2022). Surface waters are assessed as: full support, altered, or impaired.

The assessment results are the basis for the biennial statewide 303(d) List of Impaired Waters and List of Priority Surface Waters Outside the Scope of 303(d) (Table 7; Figures 16), waters altered by invasive species or flow regulation, as well as the priority waters for protection for aquatic biota and wildlife (Chapter 2). The lists identify impaired or altered waters and includes preliminary information on responsible pollutant(s) and/or physical alterations to aquatic and riparian habitat and identifies the problem, if known. Altered and impaired waters become a priority for restoration. There are only two impaired waters in the watershed, the Sleepers River and Passumpsic River in St Johnsbury due to combined sewer overflows. There are no streams listed as altered or lakes listed as either impaired or altered in the Passumpsic River Basin.

The Vermont Lake Score Card identified lakes and ponds that have increasing nutrient trends and therefore are a priority for nutrient reduction strategies. To address documented water quality concerns, the strategies proposed in the Chapter 5 Implementation Table are prescribed based on the land use sector-specific practices outlined in the Vermont Surface Water Management Strategy.

Nine rivers and streams have biomonitoring data that indicate fair or poor condition, but there is not enough data to fully evaluate the attainment of Aquatic Biota use, or monitoring results show volatile conditions from year to year (Figure 17). These streams are a priority for further assessment and are listed in Table 8 and Chapter 5's Monitoring and Assessment Table (Table 12).

The following figures and tables are grouped to show the impaired or altered waterbodies in the Passumpsic basin, their known or suspected pollutant sources, and monitoring needs for further evaluation.

## *Impaired Rivers*

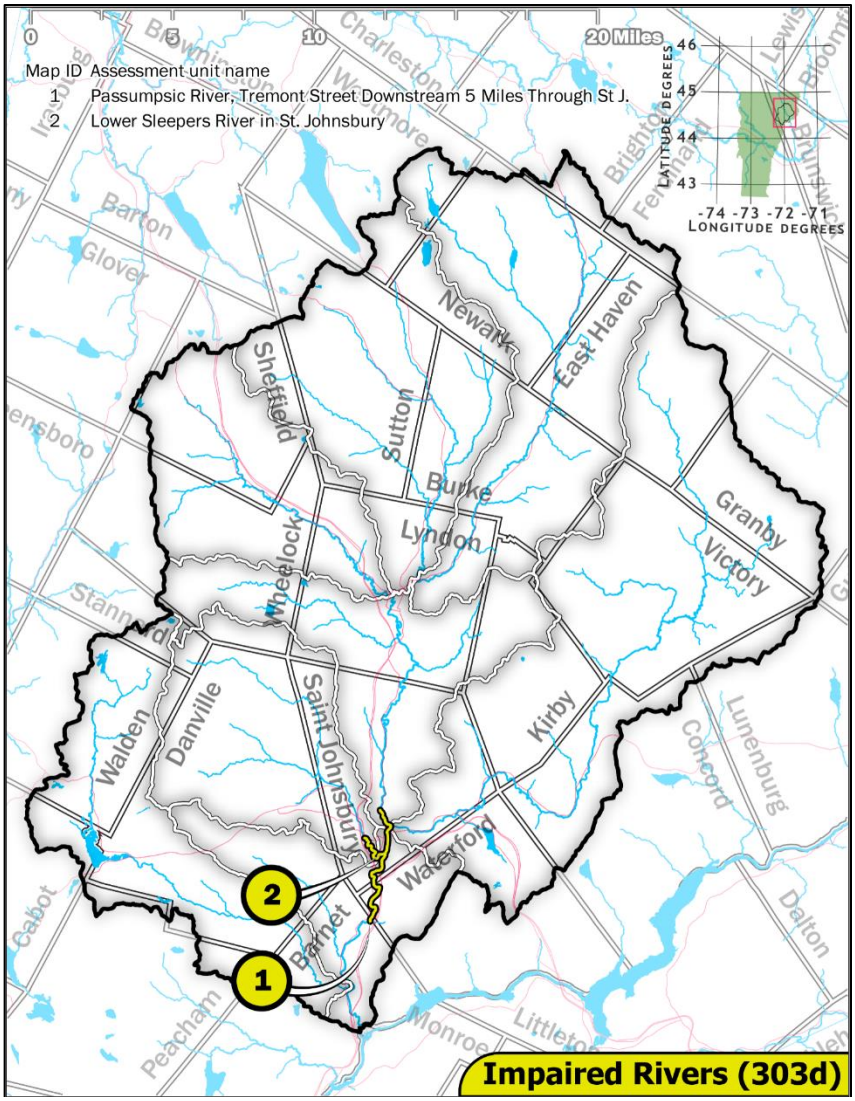



Figure 16. Impaired streams in the Passumpsic basin. Map number corresponds with Table 7.

Table 7. Impaired streams in the Passumpsic basin and their pollutants.

| Map # | Name | Pollutant | Problem | Impaired Use | List |
|---|---|---|---|---|---|
| 1 | Passumpsic River, Tremont Street Downstream 5 Miles Through St J. | E. coli | St. Johnsbury WWTF collection system passes combined sewer overflows. | Contact recreation | A |
| 2 | Lower Sleepers River in St. Johnsbury | E. coli | St. Johnsbury WWTF collection system passes combined sewer overflows. | Contact recreation | A |

## *Monitoring Priorities for Further Impairment Evaluation*

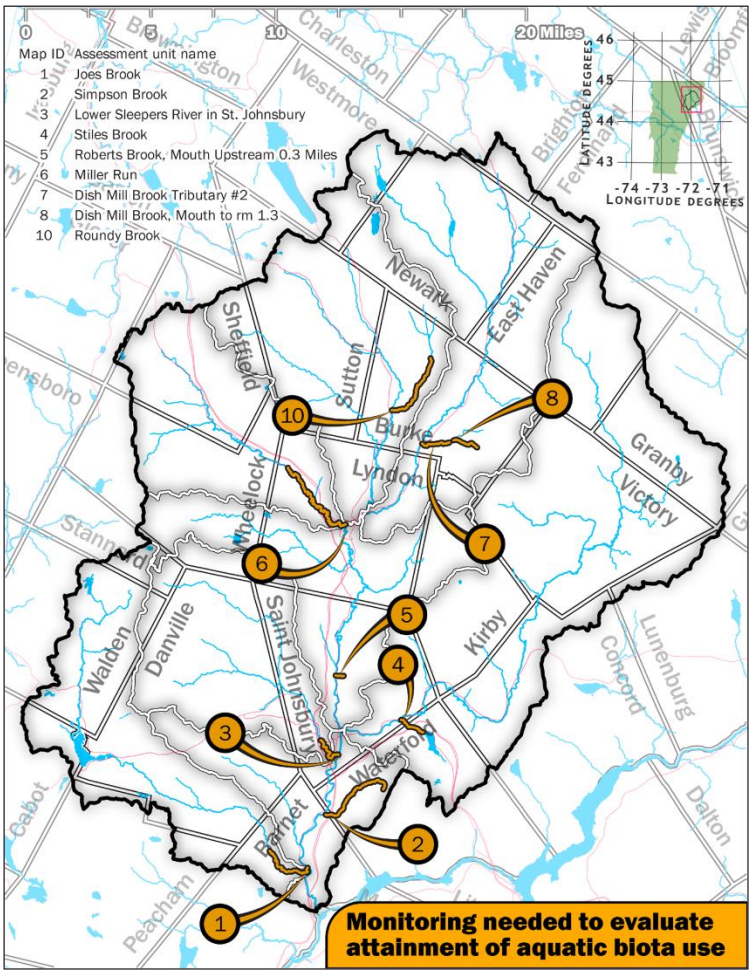



**Figure 17. Monitoring needs to determine potential river segment impairment. Map IDs correspond with information in Table 10.**

**Table 8. Monitoring needs to determine river segment impairment, from Figure 17.**

| Map ID | Name | Problem | Pollutant |
|---|---|---|---|
| 1 | Joes Brook | Lack of riparian buffer upstream | Temperature |
| 2 | Simpson Brook | Impacts to fish community, undetermined sources | Cause unknown |
| 3 | Lower Sleepers River in St. Johnsbury | Fairbanks-Morse foundry site: oil spills, other possible contaminants; parker landfill received hazardous waste; groundwater & stream sediments contain elevated metal concentrations | Metals, oil |

| Map ID | Name | Problem | Pollutant |
|---|---|---|---|
| 4 | Stiles Brook | Impacts from agriculture, Duck Pond, and I89 | Sedimentation, chloride |
| 5 | Roberts Brook, Mouth Upstream 0.3 Miles | Runoff from developed lands | Sedimentation/siltation, pollutants in urban stormwater |
| 6 | Miller Run | High embeddedness, riparian agriculture, and development | Sediment, temperature |
| 7 | Dish Mill Brook Tributary #2 | High embeddedness, erosion from parking areas | Sediment |
| 8 | Dish Mill Brook, Mouth to rm 1.3 | Scour events from increased peak flows, periodic sedimentation issues | Sediment, flow regime modification |
| 10 | Roundy Brook | Elevated embeddedness, potential road impacts | Sediment |

## B. Total Maximum Daily Loads (TMDLs)

For waters that are listed as impaired, the federal Clean Water Act requires a plan that identifies the pollutant reductions a waterbody needs to undergo to meet VWQS and it must identify ways to implement those reductions. A Total Maximum Daily Load (TMDL) is the calculated maximum amount of a pollutant that a waterbody can receive and still meet VWQS. TMDLs can be calculated for reducing water pollution from specific point source discharges or for an entire watershed to determine the location and amount of pollution reduction needed.

TBPs are implementation plans guiding the execution of actions necessary to meet TMDL reduction targets specific to each planning basin, see Chapter 4 and the implementation table for associated strategies. The Mercury TMDL is primarily focused on regional efforts to reduce atmospheric deposition and so is not described in greater detail beyond the link provided below.

TMDLs in the Passumpsic basin include:

- Northeast Regional Mercury TMDL
- Dissolved Oxygen TMDL – Long Island Sound (LIS), developed by Connecticut and New York States
    - Vermont Enhanced Implementation Plan for the Long Island Sound TMDL

### Long Island Sound Dissolved Oxygen TMDL

The Long Island Sound watershed encompasses 16,820 square miles in five states and the Province of Quebec. It is the second largest estuary on the East Coast and receives water from 16,000 miles

of rivers and streams. The 410-mile-long Connecticut River is its largest tributary. 42% or 3932 square miles of Vermont, drains to the Connecticut River. 507 square miles of those are in Basin 15.

The Long Island Sound Dissolved Oxygen TMDL released in 2000 is designed to address low dissolved oxygen, or hypoxia, in Long Island Sound bottom waters. It is often referred to as the Connecticut River Nitrogen TMDL because it is linked to an overabundance of nitrogen discharging into the Sound from the Connecticut River and other tributaries. While nitrogen is essential to a productive ecosystem, too much nitrogen fuels the excessive growth of algae. When the algae die, they sink to the bottom, where they are consumed by bacteria. The microbial decay of algae and the respiration of these organisms uses up the available oxygen in the lower water column and in the bottom sediments, gradually reducing the dissolved oxygen concentration to unhealthy levels (New York State Department of Environmental Conservation, 2000).

Due to the Long Island Sound TMDL, nitrogen is a key pollutant of concern in the Connecticut River watershed. Total Nitrogen (TN) levels show correlation with development and impervious surface increases. Wastewater discharges, stormwater and agricultural runoff are common contributors of nitrogen.

Vermont's nitrogen export to LIS is estimated to be about 12% of the total load to the Sound based on the United States Geological Survey (USGS) SPARROW model (Astor, 2019). Basin 15 is responsible for approximately 17% of Vermont's total load. This delivered loading consists of 2% from municipal wastewater treatment, 12% from developed land runoff, 9% septic system effluent, and 18% from agriculture through nitrogen fixing crops, farm fertilizer and manure. Approximately 59% of nitrogen from this Basin comes from atmospheric deposition. Figure 18 shows the delivered loading in percent contribution. Efforts to reduce atmospheric deposition have been occurring at the national level through the 1990 Clean Air Act and its amendments. Total atmospheric nitrogen deposition has declined since 1985. (Astor, 2019)

In 2017, USEPA embarked on its Nitrogen Reduction Strategy to investigate and better define control strategies to reduce nitrogen in the Long Island Sound. Information on the most current developments and strategies can be found in USEPA's Long Island Sound Study.

The sources of nitrogen to be addressed in Vermont include wastewater and septic discharges, agricultural lands, developed lands, and forest practices. Act 64, the Vermont Clean Water Act, helps implement overarching strategies and steps required to meet loading reductions for the Long Island Sound's TMDL. Each of the five watershed states completed a section of the LIS TMDL Enhanced Implementation Plan Report in 2013. To meet TMDL requirements, Vermont has implemented both regulatory and non-regulatory initiatives. These include the creation of the State's engagement strategy to develop, maintain, and enhance the Agency's partnerships; support for those partnerships, support for project prioritization, funding, and implementation; and advanced tracking methods for each land use sector.

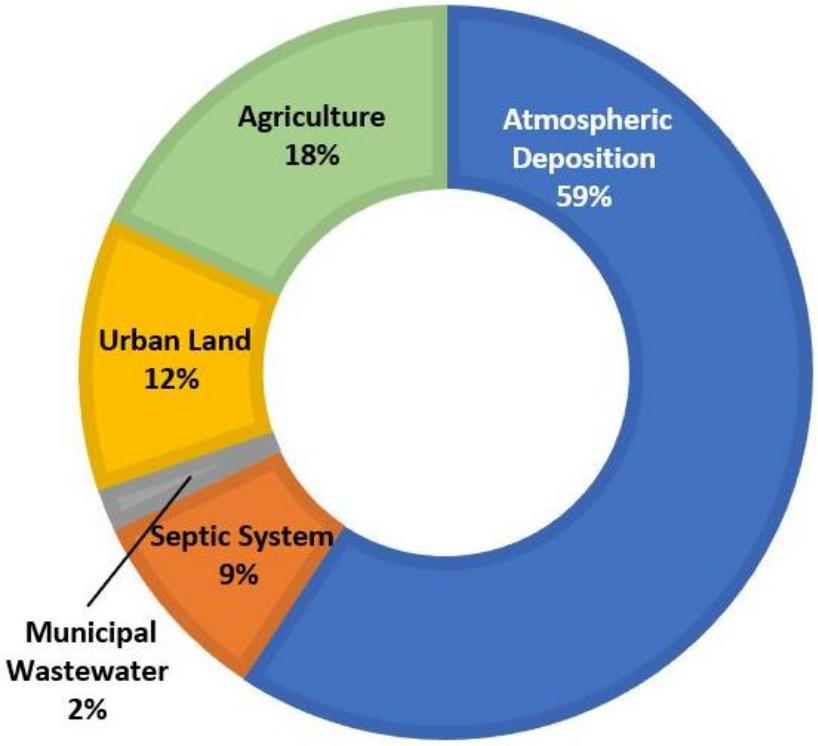



**Figure 18. Estimated Percent Nitrogen by Source in Basin 15**

The Vermont Enhanced Implementation Plan for the Long Island Sound TMDL (DEC, 2013) was added to the LIS-TMDL to address four goals:

1. To identify the Vermont sources of nitrogen as they are currently understood, across broad land use sectors, such as developed, agricultural and forested lands;
2. To identify the status and trends of important drivers of nitrogen export such as the intensity of agricultural and development activities and investigate how these might have changed since the TMDL baseline period of 1990;
3. To identify the management programs, operating at that time, that address these drivers of nitrogen loading that have a significant effect on reducing or preventing nitrogen export. A part of this is to identify a timeline as to when programs were initiated or enhanced; and
4. Using a weight-of-evidence approach, to assess the combined management programs/projects to develop a qualitative evaluation as to whether management efforts are sufficient to meet the original 2000 TMDL of a 10% non-point source nitrogen reduction and if these strategies are sufficient to maintain that control into the future (DEC, 2013).

The Vermont State section tasks TBPs with identifying actions and priority projects for the remediation of impaired and altered waters. Action items include both data collection and assessment efforts and specific implementation activities (DEC, 2013). The Implementation Table in Chapter 5 offers strategies and actions to address nitrogen reductions that are necessary to achieve compliance with the TMDL. Additionally, the Monitoring Table (Table 12) recommends continued and supplemental monitoring efforts to support the goals and fill current data gaps in nitrogen trends and source tracking.

In 2023 the Windham County Natural Resources Conservation District received funding from the Long Island Sound Futures Fund of the National Fish and Wildlife Foundation to address nitrogen inputs to the upper Connecticut River watershed of Vermont and New Hampshire.

The project, titled *Working with Agricultural Producers and Partners to Restore and Protect Water Quality in the Upper Connecticut River Basin,* has identified and gathered a bi-state team of key stakeholders and partners working in agriculture in the upper Connecticut River Valley to select best management practices for reducing Nitrogen pollution to Long Island Sound. The team will design and plan implementation trials and monitoring and assessment studies to identify BMP practices with the greatest impact on reducing Connecticut River nitrogen inputs.

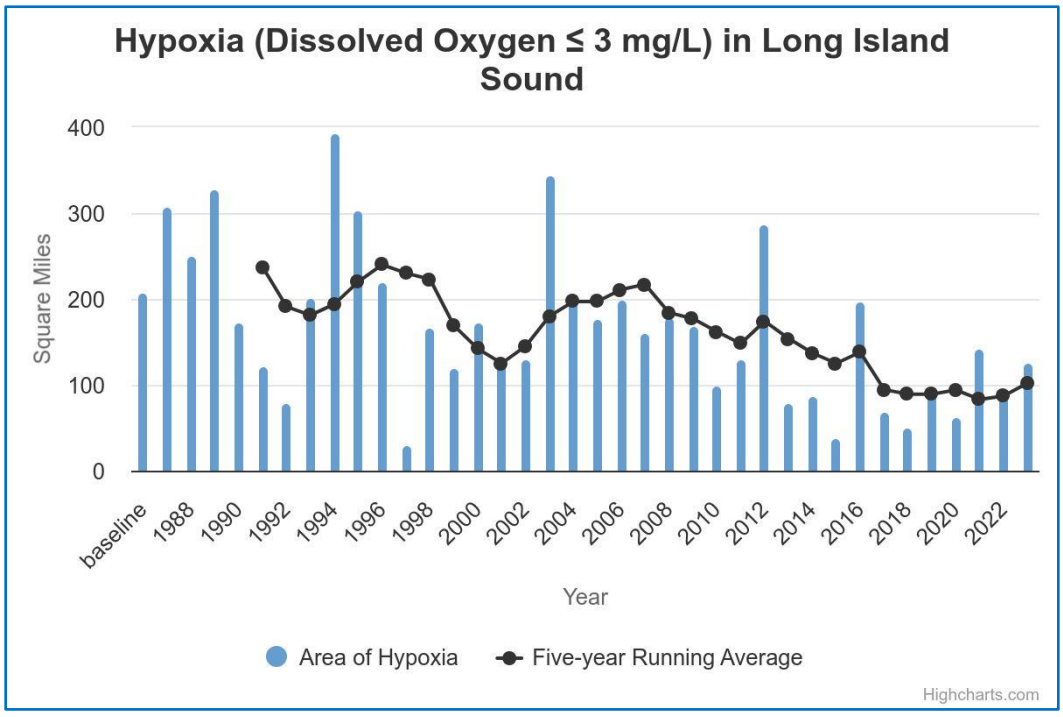



**Figure 19. Downward Trend in the Area of Hypoxia in Long Island Sound 1987 - 2023**

Progress toward the reduction of nitrogen to the Sound is being made particularly through efforts in the lower watershed in Connecticut and New York through investments in wastewater treatment and agriculture. These efforts have resulted in the total area of the hypoxic waters being reduced from 208 square miles (1987-1999 baseline period average) to 102 square miles (2019-2023 5-year average), a reduction of 51% according to the Long Island Sound Study (LIS Study, 2024).

Significant reductions in the nitrogen load are still needed to meet water quality goals by the attainment date goal of 2035. This plan puts forward strategies to help better understand and reduce Vermont's contribution.

### *State Programs to Meet Regulatory Targets*

Regulatory programs play a significant role in ensuring that pollutants and stressors responsible for degraded water quality are addressed. To meet TMDL requirements, Vermont has implemented both regulatory and non-regulatory initiatives including a wide array of permits meant to protect all Vermont's natural resources from degradation. These regulatory programs can be found through the Environmental Assistance Office which provides assistance to Vermonters in need of permits.

## Engagement Strategy

The Watershed Planning Program engages partners using strategies that strengthen the partners' sense of ownership and therefore participation in the planning process and implementation. The desired outcomes of the state's engagement strategy work toward:

- Multi-partner collaboration across sectors and localities to assist with developing, writing, and implementing TBPs;
- Strategic inclusion and engagement with different sectors and localities throughout the planning process to ensure that all concerns, needs, and goals are addressed; and
- Strategic communication efforts to ensure understanding of and support for the plan among key stakeholders as well as throughout the watershed;
- Financial support and technical assistance to partners and develop programs to expand capacity in our stakeholder networks.

# Chapter 4 – Strategies to Address Pollution by Sector

ANR's approach to remediation of degraded surface waters and protection of high-quality waters includes the use of both regulatory and non-regulatory tools with associated technical and financial assistance to incentivize implementation. Tactical basin plans address water quality by land use sector (Figure 20). Ongoing protection and restoration efforts and recommendations to meet water quality objectives are developed for each sector. These recommendations support the development of the strategies in the Chapter 5 Implementation Table.

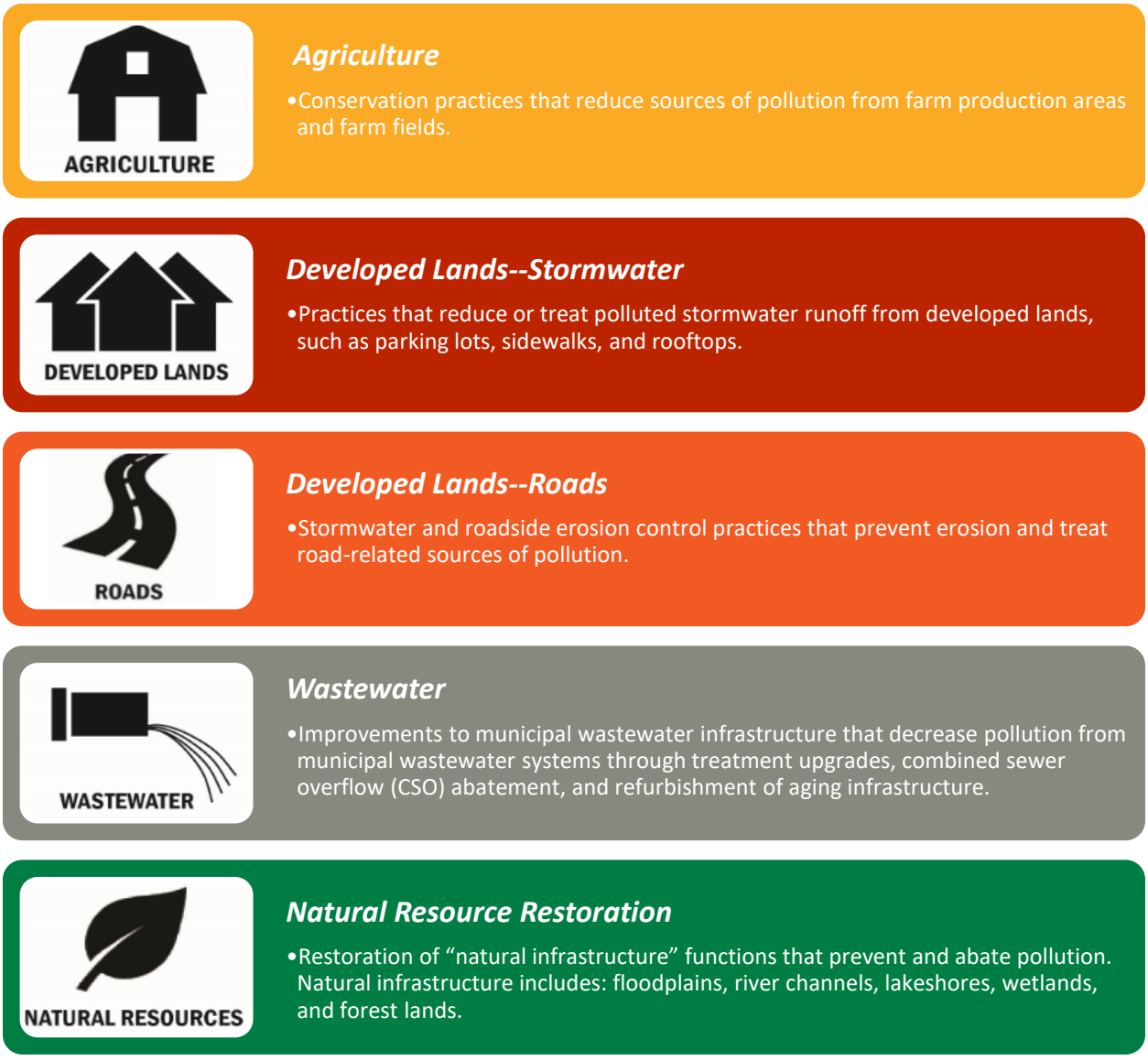



**Figure 20. Land use sector framework with practices used to enhance, maintain, protect, and restore water quality.**

# A. Agriculture

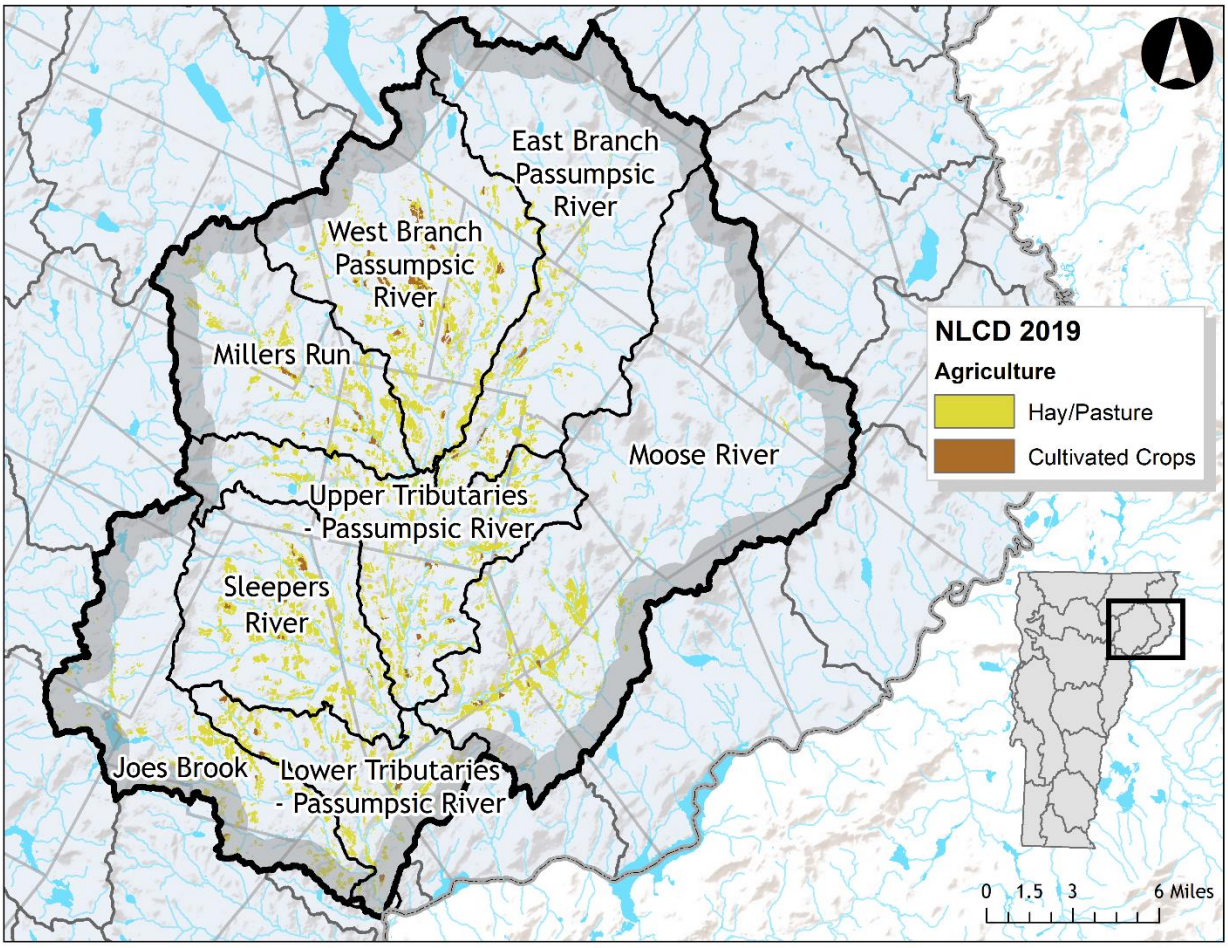



**Figure 21. Agricultural land use in the Passumpsic basin.**

Agricultural land use makes up approximately 8.2 percent of the Passumpsic basin with 0.5 percent in cultivated crops and 7.7 percent in hay or pasture. Agricultural lands are distributed among the lower reaches of most major tributaries and along the Passumpsic River itself (Figures 21, 22). Pasture and hay lands are the most widespread, though cultivated crops make up some portion of the West Branch of the Passumpsic River watershed and scattered through other sub-watersheds.

Agricultural runoff constitutes 18% of the Passumpsic basin's estimated TMDL baseline total nitrogen loading to Long Island Sound. Agricultural runoff may also be one contributing source of phosphorus to Joes Pond which has increasing phosphorous concentrations (Chapter 3 Figure 10). The following sections describe regulatory programs and non-regulatory tools to address agricultural runoff to surface waters during this plan cycle.

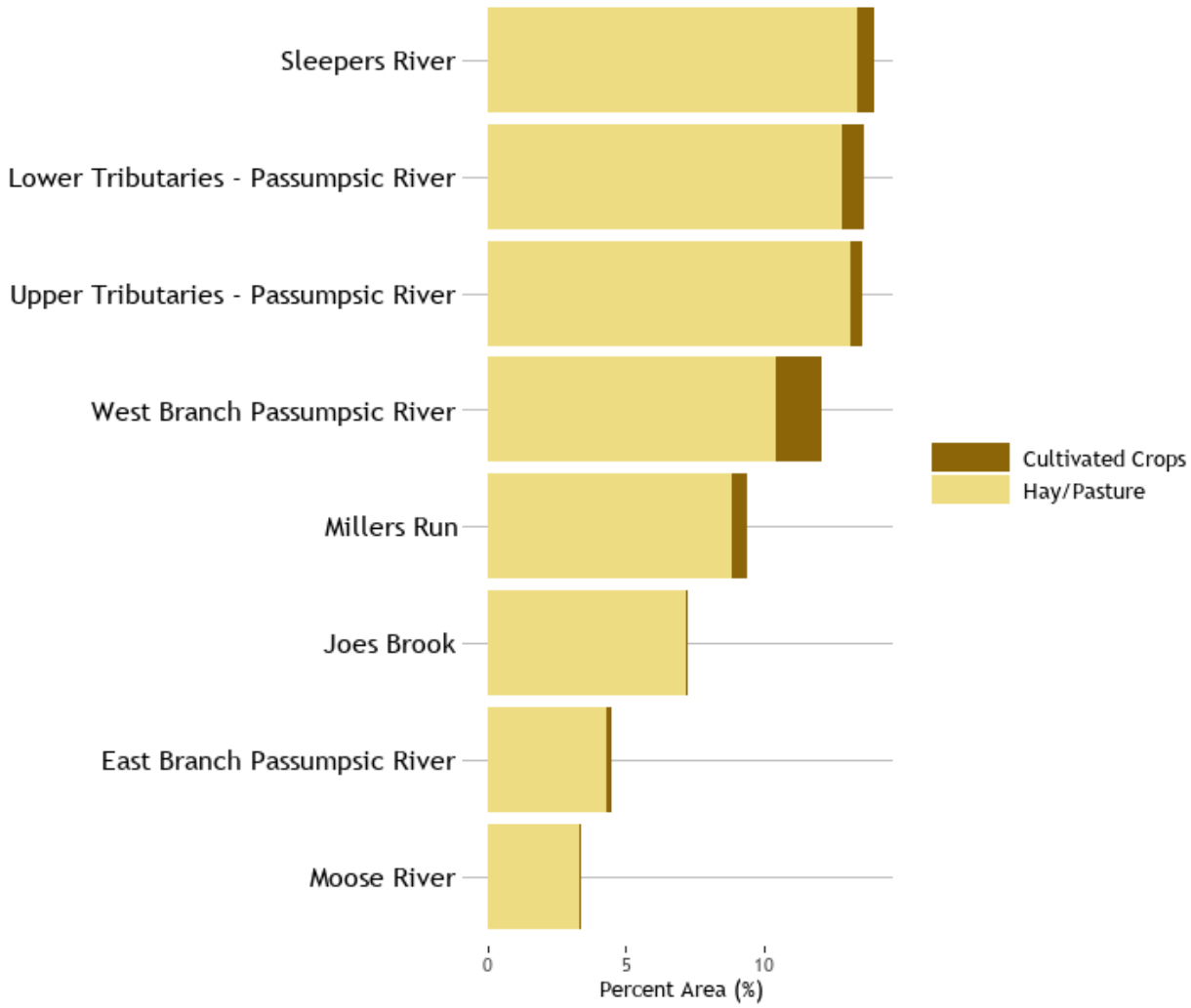



**Figure 22. Agricultural land use in the Passumpsic watershed by HUC 12 watershed.**

## *Regulatory programs*

Vermont Agency of Agriculture, Food, and Markets (AAFM) regulatory programs work towards protecting surface waters by requiring baseline farm management practices to ensure environmental stewardship. The revisions of the Required Agricultural Practices (RAPs) in 2016 and 2018 aim to reduce nutrients such as TP and nitrogen entering state waterways. The RAPs apply to different types of farms, farm sizes and farming activities. In addition to the RAPs, Vermont Large and Medium farm operations are regulated by additional sets of rules promulgated by the AAFM based on farm animal numbers.

There is currently one permitted Large Farm Operation and there are no Medium Farm Operations in the basin. Large farms are inspected annually and medium farms are inspected once every three years by AAFM. These farms must comply with the Required Agricultural Practices (RAPs), Large Farm Operation Rule and Medium Farm Operation permitting program requirements as applicable, and the VWQS.

At the writing of this plan, an estimated 14 Certified Small Farm Operations are in the Passumpsic Basin, that are required to certify annually with AAFM, will be inspected at least once every seven years, and need to comply with the RAPs. The AAFM estimates there are 51 Small Farm Operations in the basin that do not meet the thresholds of a certified small farm and are not required to receive a routine inspection by AAFM, but still need to comply with the RAPs. Outreach will continue to help landowners understand where they fall within the RAP farm categories and the RAP requirements.

AAFM regulatory programs support farmers to ensure their clear understanding of the RAPs and program rules, while helping assess, plan, and implement any conservation and management practices necessary to meet water quality goals. Inspections by AAFM include assessments of farm nutrient management plans, production area assessments of all facilities associated with the permitted or certified operation, and cropland management assessments in accordance with RAPs and permit rules as applicable. As a result of regulatory farm inspections and technical assistance provided to farms in the basin, in SFY 2023 approximately 81% of farm facilities inspected the Passumpsic basin had production areas that were compliant with the RAPs and farm permits. The compliance rate of production areas in the Passumpsic Basin is higher than the overall Connecticut River Basin compliance rate in SFY 2023, in which approximately 69% of farm facilities inspected had production areas that were compliant. Information regarding farm inspections, compliance, and enforcement actions can be reviewed on AAFM's Water Quality Interactive Data Report.

### *Technical and Financial Assistance*

Availability of technical and financial assistance throughout the basin is provided by the Caledonia County Natural Resources Conservation District, Essex County Natural Resources Conservation District, UVM Extension, AAFM, Connecticut River Watershed Farmers Alliance (CRWFA), and the Natural Resources Conservation Service (NRCS), who help facilitate compliance with water quality regulations and the voluntary adoption of conservation practices. AAFM and NRCS funded programs provide most of the financial support directly to farmers as well as to the agricultural partner organizations. Outreach, education, technical assistance, and financial assistance is available for farmers to implement field Best Management Practices (BMPs), such as cover cropping, crop rotation, and reduced tillage practices, and available for farmers to implement farmstead BMPs, such as waste storage facilities or clean water diversion practices. These agricultural assistance and outreach programs are essential tools in promoting field and farmstead BMPs that protect water quality, improve soil health, and increase farm viability.

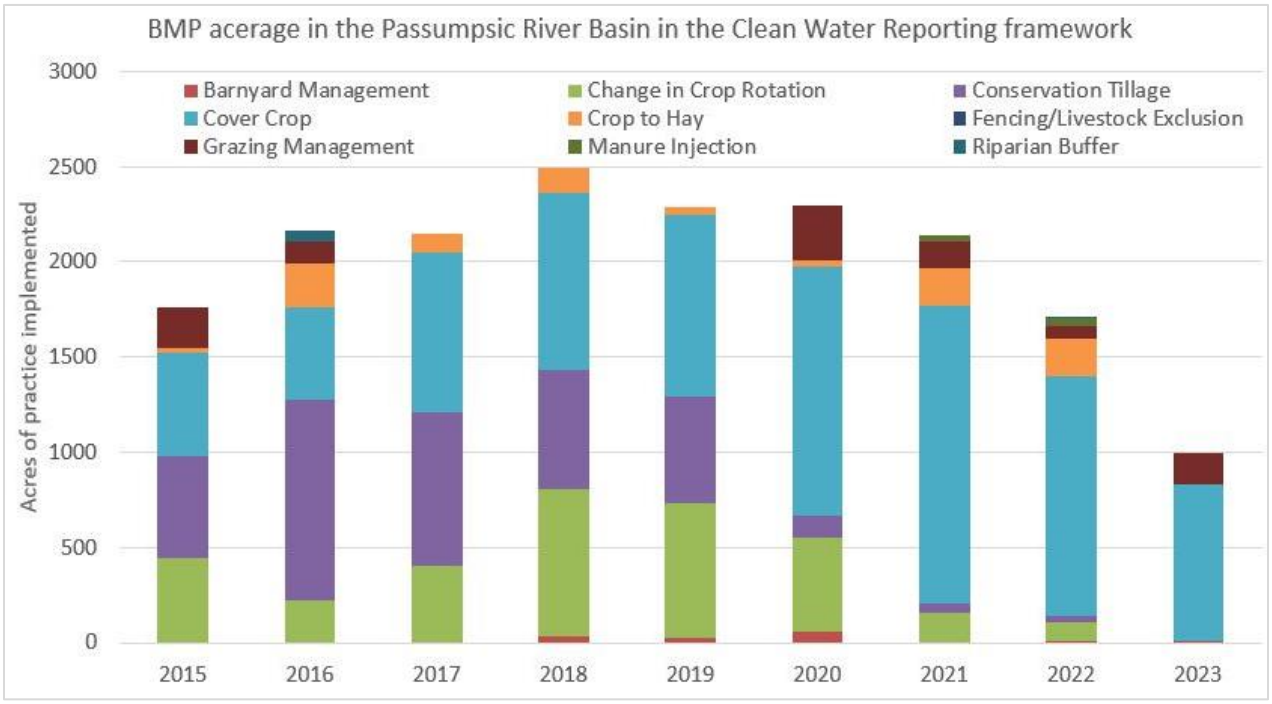



**Figure 23. Implemented agricultural practices in the Passumpsic basin by state fiscal year.**

Agricultural outreach and assistance programs also track conservation practice implementation through grant reporting requirements that are then reported and accounted for in the Clean Water Reporting framework. Based on this reporting framework, cover cropping is the most popular BMP implemented in the Passumpsic basin; while grazing management, conservation tillage, and manure injection cover fewer acres and are more annually variable (Figure 23). The acreage of practices implemented peaked in 2018 through 2021 and has fallen since this time although it is likely that there is some underreporting of practice acreage in 2023 due to several potential reasons. Cover cropping has been implemented on a large portion of corn acreage in the basin in 2021 (1560 acres in SFY2021 out of around 2255 total crop acres) and FY2022 (1264 acres out of a total of 2457 acres) based on the National Agricultural Statistics Service CroplandCROS for this year (USDA , 2023). Several other practices also peaked in earlier years with conservation tillage peaking in 2016 at 1048 acres and change in crop rotation peaking at 771 acres in 2018, while this acreage has dropped in FY2022 to 31 and 99 acres respectively. One potential reason for reductions in practice acreage is the loss of farmland in the watershed as was brought up by Agricultural partners, however according to the National Agricultural Statistics Service, the acreage of cornland in the Passumpsic has remained relatively consistent since 2018, between 2056 acres in 2018 to a high of 2516 acres in 2023 so the loss of corn land does not seem to be a driver (USDA , 2023). However, it is possible that farmers are implementing practices that are not funded by state or NRCS funding programs and these practices may not be tracked.

Agricultural partners identified that improving information sharing of practices to reduce nitrogen loading and associated technical support to work with farmers to better target nitrogen application could be the most effective way to reduce nitrogen loading from agricultural lands in the Passumpsic River watershed. Partners also identified opportunities to better address water quality challenges with small beef and other farm operations in the watershed as the smaller scale of these operations make it hard for producers to participate in cost share programs. Partners also suggested that there may be opportunities to share equipment from the Upper Valley to this basin as the growing season may be offset enough that the equipment could move north for use in this basin after it is no longer needed in the upper valley.

AAFM and partners provide educational opportunities and technical assistance to farmers to promote and assist with conservation practice adoption. Between 2018-2022, AAFM and the Agricultural Clean Water Initative Program supported 3 education events with 55 attendees in the Passumpsic basin. Over the same period, UVM Extension, Conservation Districts, and AAFM conducted approximately 117 on-farm technical assistance visits at 33 farms in the Passumpsic basin.

Resource guides like Franklin County Natural Resource Conservation District's Assistance for Agricultural Producers and the development of simpler brochures may be a helpful complement to a potential farm team model in the basin. Providers further highlighted that emerging resources for new farmers, small-scale farmers, and urban farmers are improving equity in agricultural funding opportunities in the basin, but that providers need a way to identify these farmers and target them for outreach on available programs.

## B. Developed Lands

Stormwater runoff from developed lands is a significant threat to water quality in Vermont. Stormwater runoff is any form of precipitation that flows over the land during or after a storm event or snowmelt. Along this route stormwater picks and carries pollutants with it to the waterbodies it enters. On undeveloped lands, such as forests and meadows, a portion of this runoff is absorbed into the ground through infiltration while the rest takes a relatively slow path to nearby rivers, lakes, and ponds. On developed lands, however, infiltration is reduced by impervious surfaces which increase the velocity and volume of runoff into rivers and lakes. This leads to an increased frequency and intensity of flooding as well as a greater likelihood that runoff will become contaminated with pollutants. The result is increased erosion and property damage, degraded aquatic and terrestrial habitats, and threats to public health via contaminated drinking water and recreational pursuits.

Developed lands make up about 6% of the land cover in the Passumpsic basin. These lands include the general land use classes of urban, residential, and industrial areas, as well as paved and unpaved roads. Nitrogen loading from developed lands account for approximately 12% of all nitrogen loading from the basin to the Connecticut River. The LIS TMDL portion of Chapter 3 above provides additional detail on the quantitative TMDL nitrogen reduction efforts. Stormwater runoff may also be a contributing factor to several lakes and ponds in this basin with increasing nutrient trends and is also a potential driver in water quality concerns for several waters that need further assessment to determine WQ status including Dish Mill Brook, Roundy Brook and Roberts Brook. Developed lands runoff may also be a contributor to flooding concerns in Lyndon and other areas of the basin. The following sections describe regulatory programs and non-regulatory tools to address stormwater runoff to surface waters during this plan cycle.

## Stormwater

The tactical basin planning approach engages local, regional, and federal partners in the development of strategies needed to accelerate adoption and monitoring of stormwater-related Best Management Practices (BMPs) to meet the state's clean water goals and TMDL targets. Basin stakeholders have been actively participating in voluntary actions and implementing priority projects and municipalities are working on meeting regulatory requirements and are working to remediate identified discharges.

Stormwater mapping, Indirect Discharge Detection and Elimination studies and Stormwater Master Plans are the tools used to identify stormwater actions needed to address stormwater-related water resource impairments.

Regulatory requirements ensure proper design and construction of stormwater treatment and control practices as well as construction-related erosion prevention and sediment control practices, necessary to minimize the adverse impacts of stormwater runoff to surface waters throughout Vermont. Stormwater permits for developed lands include:

- Operational Stormwater Permits
- Construction Stormwater Discharge Permits
- Municipal Separate Storm Sewer System (MS4) General Permits
- Multi-Sector General Permit (Industrial)

### *Stormwater General Permit 3-9050 (Three-Acre General Permit)*

General Permit 3-9050 addresses runoff from impervious surfaces. This permit covers all operational stormwater permitting, including new development, redevelopment, and permit renewal. Projects that expand or redevelop one half-acre (0.5 acres) or more of impervious surface are

required to apply for stormwater operational permit coverage. Additional information on the ½ acre threshold can be found on the stormwater program website. This permit serves as the statutorily required "Three-Acre General Permit" under the Vermont Clean Water Act which takes effect in Basin 15 in 2033.

## *Stormwater Mapping and Master Planning*

Stormwater infrastructure mapping projects are completed for municipalities by the Clean Water Initiative Program to supplement any existing drainage data collected by towns with the intention of providing a tool for planning, maintenance, and inspection of stormwater infrastructure. Town reports can be found by clicking on the town on the left side of the municipal stormwater website. As of spring 2024, all municipalities in the basin where mapping is planned have been mapped including Barnet, Burke, Concord, Danville, Lyndon, Sheffield, St. Johnsbury.

The reports and maps for each town provide an overall understanding of the connectivity of the storm drainage systems on both public and private properties, raise the awareness of the need for regular maintenance, and identify potential stormwater retrofit opportunities. These reports identify potential priority projects and provide information necessary to develop a stormwater master plan. Stormwater Master Plans are developed with municipal and public involvement and further prioritize projects identified in initial mapping efforts, offering a strategic approach to address stormwater runoff in the plan focus area. Stormwater master planning has been completed the towns of Burke, Concord, Lyndon, St. Johnsbury and stormwater master planning is in progress in the Town of Danville. Plans are available at DEC's Stormwater Infrastructure Mapping Directory.

These stormwater master plans have led to the implementation of 13 and design of three stormwater projects in the basin including:

**From the St. Johnsbury SWMP the installation of:**

1. Oak Street neighborhood scale infiltration practices
2. Town Garage sedimentation basin
3. Bay Street Sand Pile removal
4. Leonard Field Almshouse Road Stormwater treatment practice
5. Western Ave outfall stormwater treatment instillation
6. Undercliff road gully stabilization
7. Pearl Street parking lot 100% design

**From the Lyndon SWMP and installation of:**

8. Fenton Chester Arena treatment practices
9. Rain garden, infiltration trench, and trail erosion control at Lyndon Institute
10. Vermont University varsity field stormwater retrofit.
11. Vermont University Gravel wetland
12. South Prospect Gully Remediation

**From the Dish Mill Brook SWMP and installation of:**

13. Several rain gardens at Burke Mountain Resort
14. Instillation of an infiltration basin at Burke Mountain Academy.
15. Several designs for large scale stormwater at the Burke Mountain Base Lodge and Mid Burke Lodge

**From the SWMP for the Town of Concord and installation of:**

16. Folsom Ave gravel infiltration basin and underground detention basins

These implemented practices include the majority of high priority practices that have been identified through stormwater master plans. With the large number of stormwater projects that have implemented or funded for implementation in this Basin (16) which is the fourth highest of all 15 basins in Vermont, the focus for this basin is to ensure that these stormwater practices are maintained to support continued functionality and to learn how to more effectively implement practices in the future. Because of this, a priority for this planning cycle is to visit all the completed stormwater practices and evaluate conditions and functionality and address maintenance needs with O&M responsible parties.

In addition to this, there are a few projects which have designs but have not moved forward towards implementation due to lack of landowner support for implementation at this time, and it is a priority to continue outreach to these landowners to move these projects towards implementation. There are several other potential projects which have been identified as a priority for further design when landowner interest can be secured, and projects may also be identified though the Danville stormwater master planning effort.

## *Illicit Discharge Detection & Elimination Studies*

Illicit discharges are discharges of wastewater or industrial process water into a stormwater-only drainage system. All towns in the basin with mapped stormwater have completed, in-progress (Wheelock) IDDE studies. Study outcomes are provided in four reports:

- Detecting and Eliminating Illicit Discharges in St. Johnsbury to Improve Water Quality (9.2 MB PDF) (2015)
- Detecting and Eliminating Illicit Discharges in the Upper and Middle Connecticut River Basin: Final Report (2017)
- Statewide Contract No 3 Illicit Discharge Detection and Elimination Study: Final Report (2021)
- Statewide Contract No 4 Illicit Discharge Detection and Elimination Study: Final Report (2023)

Most of these illicit discharges have been identified and eliminated. Where sources were difficult to locate, compliance was difficult, or the infrastructure was no longer in use follow-up actions are identified in the reports. This plan recommends the follow-up on recommended actions from previous studies, and the elimination of discharges identified by new studies.

### *Stormwater Outreach and Education*

Many of the stormwater issues associated with developed lands can be prevented or mitigated using Low Impact Development and Green Stormwater Infrastructure systems and practices. These concepts strive to manage stormwater and pollutants by restoring and maintaining the natural hydrology of a watershed. Rather than funneling stormwater off site through pipes and infrastructure, these systems (gardens or permeable materials) focus on infiltration, evapotranspiration, and storage as close to the source as possible to capture runoff before it gets to surface waters.

The Vermont Green Infrastructure Toolkit is a project of the ten Regional Planning Commissions of the Vermont Association for Planning and Development Agencies and the Agency of Natural Resources' Water Investment Division. The toolkit is a clearinghouse of information useful to municipalities to promote the adoption of Green Infrastructure policies and practices to combat the problems caused by urban, suburban, and rural stormwater runoff.

Voluntary actions by individual landowners and residents can also reduce local stormwater runoff issues if adopted at scale. Several outreach campaigns have been developed and implemented across the state to encourage practices like reducing lawn mowing and fertilizing, using permeable pavers, redirecting downspouts, picking up pet waste, lessening salt application, and installing rain barrels. Nationwide, the Environmental Protection Agency provides general Stormwater Smart Outreach Tools to promote sound stormwater management.

## Roads

It is estimated that more than 75% of Vermont roads were constructed prior to any requirements for managing stormwater runoff (ANR, 2012). Where road networks intersect stream networks, roads and their ditches effectively serve as an extension of the stream system. Roads can increase stormwater runoff, and, in this basin, unpaved roads are an important source of sediment to receiving waterbodies.

Road runoff also contributes other pollutants, especially chlorides, that can impair streams and lakes. Roads can impinge on stream floodplains and be a barrier to aquatic organism passage due to undersized or perched culverts. Road runoff also results in sediment that may contribute to elevated chloride and phosphorus levels or increasing phosphorus concentrations in lakes; therefore, Lake Wise efforts and Lake Watershed Action Plans (described in the Lakes section below) consider the outcomes of road erosion assessments alongside other sources of water quality degradation.

Tactical basin planning engages local, regional, and federal partners to accelerate the implementation of transportation-related practices to meet the state's clean water goals. Two regulatory programs, the Municipal Roads General Permit (MRGP) and the Transportation Separate Storm Sewer System Permit (TS4) are driving road water quality implementation efforts in the basin.

### *Municipal Roads General Permit*

Road Erosion Inventories (REI) are used by Vermont municipalities to:

- identify sections of local roads in need of sediment and erosion control,
- determine individual road segment compliance with MRGP required practices,
- prioritize road segments that pose the highest risks to surface waters, and
- estimate costs to remediate those sites using Best Management Practices.

REI's are required by the Municipal Roads General Permit. The MRGP is intended to achieve significant reductions in stormwater-related erosion from municipal roads, both paved and unpaved. The permit is required by the Vermont Clean Water Act (Act 64) and the Lake Champlain Phase 1 TMDL (DEC, 2015). As of 2023, road segments are surveyed and scored according to either open drainage REI or closed drainage REI supplemental documents.

The implementation of the priorities identified in REI's will reduce sediment, nutrients, and other pollutants associated with stormwater-related erosion generated from unpaved municipal roads and outfalls. A secondary benefit of upgrading roads to MRGP standards is improving the flood resilience of the municipal transportation system from the increased frequency of localized high intensity rain events associated with climate change. The inventories are conducted for "hydrologically-connected roads." Hydrologically connected roads are those municipal roads within 100' of or that bisect a wetland, lake, pond, perennial or intermittent stream or a municipal road that drains to one of these water resources. These road segments can be viewed using the Stormwater -

Road Segment Priority layer on the ANR Natural Resource Atlas and REI results by town can be viewed in the MRGP Implementation Table.

Based on protocols developed by DEC with the assistance of the Regional Planning Commissions, all the towns in the basin have completed initial REIs as of summer 2024. Some towns do have a significant portion of roads with incomplete data, including Barnet, Lyndonville Village, St Johnsbury, and Waterford. Towns were required to bring 15% of connected segments scoring *Partially Meeting* or *Not Meeting* to the MRGP standards or *Fully Meeting* status by December 31, 2022. *Very High Priority* connected segments will have to meet standards by December 31, 2025, for all road types, except for Class 4 roads, which will have to meet standards by December 31, 2028. Towns will report and manage their progress annually via the MRGP Implementation Table Portal database. For additional information see the DEC Municipal Roads Program.

DEC reissued the MRGP in January 2023. The new permit continues the implementation requirements of the previously issued permit, requiring towns to upgrade at least 7.5% of their non-compliant segments to meet MRGP standards annually. The re-issued permit requires a second, town-wide reassessment of all hydrologically connected segments by the Fall of 2027. After the updated REI is completed, 20% of total *Very High Priority* segments will be required to be upgraded to meet MRGP standards each year, as part of the 7.5% annual requirement mentioned above. One change in the reissued MRGP is that the Active Channel Width is now required for new intermittent stream crossings, as well as replacements to existing non-compliant intermittent structures.

This plan recommends that technical and financial assistance be provided to towns to complete the new, required REIs and for towns interested in implementing road projects with water quality benefits. During the first round of REIs completed by towns NRCDs were able to access funding through Category A grants to work with towns to complete REIs and provide support to towns in developing initial grant applications to implement projects. Priority projects for water quality are those projects that are "*very high priority*" and with lakes that have increasing nutrient trends related to road stormwater runoff (Figure 10). Resources available from the Clean Water Fund (e.g., VTrans Municipal Grants-in-Aid, VTrans Better Roads grants) assist with development of designs, capital budgets,cost estimates and implementation of road projects. Completion of these projects may be counted towards meeting the requirements of the MRGP.

St. Johnsbury, Concord, Newark, Burke, Walden, Wheelock, Cabot and Granby are priority towns for funding because they have the highest percentage of non-compliant roads in the basin to be improved (Figure 24). Priorities for funding road assessments or improvements also include watersheds of lakes with increasing nutrient trends (Joes Pond, Bald Hill Pond, Newark Pond), priority road-related projects identified in Stormwater Master Plans or Lake Watershed Action Plans (not yet completed in the basin but see the Lakes section below), as well as road segments above the village of Lyndonville where road runoff and sedimentation may contribute to flood hazards.

Priorites for technical support to towns for completion of REI and priority projects is for the towns of Wheelock, Walden, Burke, and Newark where this technical support is most needed.

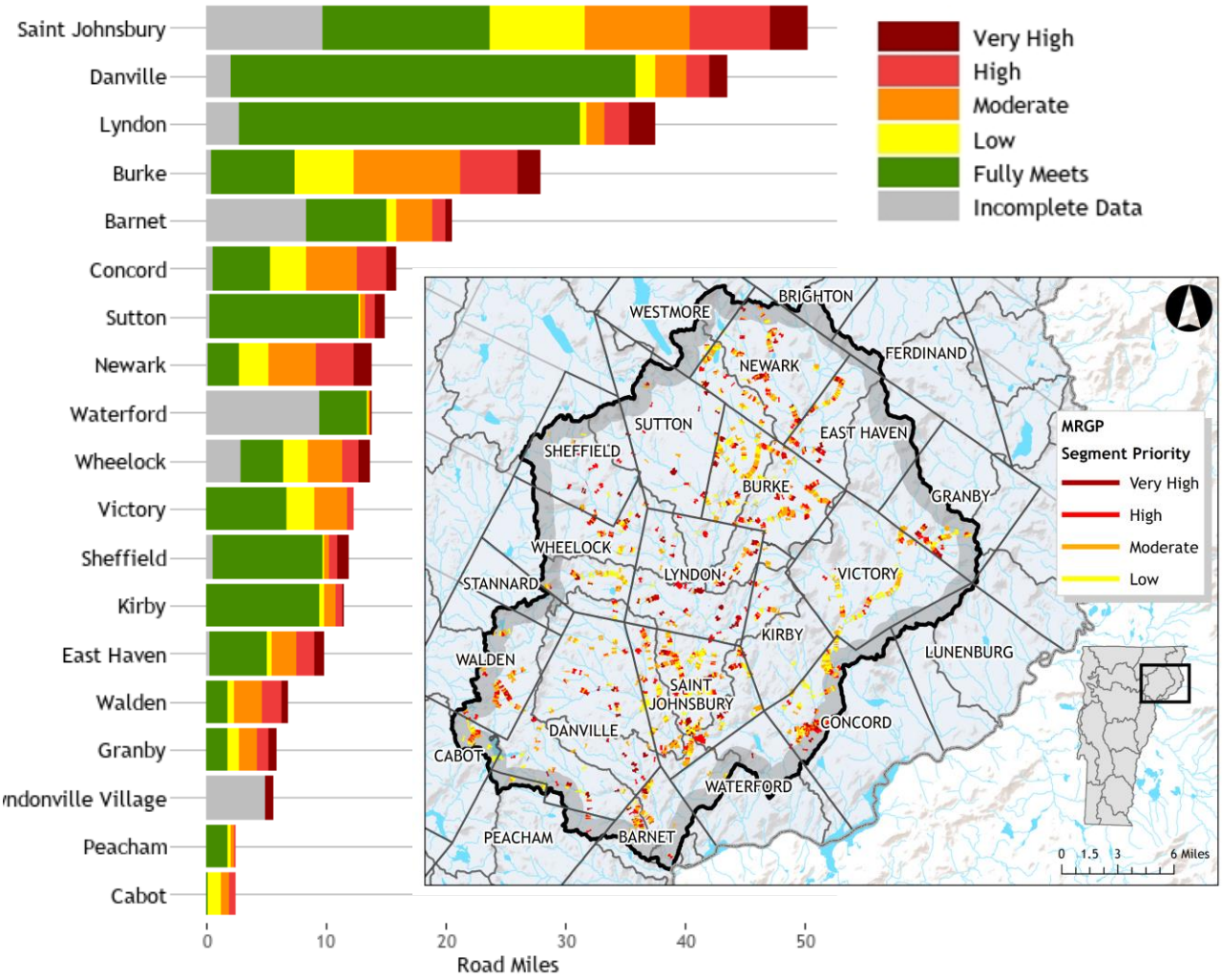



**Figure 24. Road miles by MRGP improvement priority in Passumpsic basin towns and the distribution of non-compliant segments across the basin. Visit the ANR Atlas for segement data. Fully compliant segments or those with incomplete data are not mapped here.**

## *VTrans Municipal Grants in Aid & Vermont Local Roads*

The VTrans Municipal Grants In Aid Program provides technical support and grant funding to municipalities to promote the use of erosion control and maintenance techniques that save money, while ensuring best management practices are completed in accordance with the MRGP. The Vermont Local Roads team provides training, technical assistance, communication tools and opportunities for information exchange to assists municipalities improve their road networks. These programs help implement the strategies described here and listed in Chapter 5.

### *Transportation Separate Storm Sewer System General Permit – TS4*

The Transportation Separate Storm Sewer System General Permit (TS4) covers stormwater discharges from all Vermont Agency of Transportation (VTrans) owned or controlled impervious surfaces. The TS4 general permit combines the stormwater requirements for VTrans associated with its designated regulated small MS4s; industrial activities, commonly regulated under the Multi-Sector General Permit; and previously permitted, new, redeveloped, and expanded impervious surface, commonly regulated under State Operational Stormwater permits.

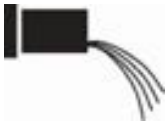
### *Vermont Transportation Resilience Planning*

VTrans has also developed the Vermont Transportation Resilience Planning Tool as a web-based application that assesses the risk to bridges, culverts, and road segments based on their vulnerability to damage from floods and the criticality of their location in the roadway network, and then identifies potential mitigation measures based on the factors driving the vulnerability. The use of this tool to prioritize projects is part of VTrans Resilience Improvement Plan.

### *Vermont Road and Bridge Standards*

In addition to the MRGP, towns can voluntarily adopt the most current version of the Vermont Road and Bridge Standards. These standards are administered by VTrans and go above and beyond MRGP standards. For example, municipalities may adopt MRGP standards for non-hydrologically connected roads. Towns adopting the Vermont Road and Bridge Standards may be entitled to higher cost share rates in federally declared flood event reimbursements. DEC will coordinate with VTrans District Offices to gather up to date information on adopted Road and Bridge Standards, coordinate outreach to municipalities, and update the Vermont Flood Ready website.

Managing road runoff in the upper watershed catchments will lessen the pressure on the downstream areas receiving larger contributions of runoff. Waters being impacted or impaired lower in the watershed does not negate the need for action high up in the watershed. Lack of good management in the upper parts of the sub-basins can often be the cause of water quality issues further downstream due to cumulative impacts. For this reason, road BMPs for water quality are recommended basin wide and on steep slopes.



## C. Wastewater

Wastewater discharges to surface waters or ground waters represent a regulated and readily measurable and controlled source of pollutants, including pathogens and nutrients. Vermont addresses these discharges primarily through implementation of the National Pollutant Discharge Elimination System (NPDES) permit program as well as and Indirect Discharge and other state permit programs. DEC provides financial assistance and technical assistance to municipalities and other permittees to upgrade wastewater treatment infrastructure and along with partners supports the community's development of community onsite systems and maintenance of residential onsite systems.

## Direct Discharges from Wastewater Treatment Facilities

In the Passumpsic basin, four municipal and one industrial wastewater treatment facility treat wastewater to established standards identified in NPDES permits before discharging it into a receiving water (Table 9). Three of the municipal wastewater treatment facilities (WWTFs) receive wastewater originating from a combination of domestic, commercial, and industrialactivities, while the Lyndonville facility receives wastewater originating from filter backwash at the village Drinking Water Treatment Facility.

An overarching consideration for the issuance of wastewater discharge permits in the Basin is the Long Island Sound TMDL for nitrogen, in addition to usual contaminants such as E. coli, total suspended solids, and biochemical oxygen demand. This multi-state TMDL has been promulgated with interim waste load and nonpoint source nitrogen load allocations. At issuance of this Plan, all facilities are operating under permits developed under a nitrogen permitting strategy whereby all Vermont WWTFs ultimately discharging to the Connecticut River must, collectively, discharge no more than 1,727 lbs. TN/day. Each individual facility has a unique Total Nitrogen (TN) loading limit. In addition to the nitrogen loading limit, WWTFs are required to develop optimization plans for maximizing nitrogen removal and regularly monitor for nitrogen compounds.

Before issuing the permit, the DEC WSMD conducts a reasonable potential analysis to ensure all water quality criteria in receiving streams are met. The Wastewater Management Program is working with the Monitoring and Assessment Program to increase the frequency of instream sample collection upstream of WWTFs prior to permit renewal. The upstream data is used during the reasonable potential analysis, described below, to calculate the resulting downstream concentration once mixed with the WWTF effluent under critical conditions to determine if there is reasonable potential to violate VWQS. The increased instream sampling as well as increased effluent sampling requirements being incorporated into WWTF permits contribute to more statistically accurate, data-based determinations for WWTF permit effluent limits.

Permit limitations must control all pollutants or pollutant parameters (whether conventional, nonconventional, or toxic pollutants) which are or may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality

standard, including state narrative criteria for water quality. At each renewal, permit writers use this "reasonable potential analysis" to determine whether a discharge, alone or in combination with other sources of pollutants to a waterbody and under a set of conditions arrived at by making a series of reasonable assumptions, could lead to an excursion above an applicable water quality standard. If the expected receiving water concentration determined exceeds the applicable VWQS at critical conditions, limits are included in the permit. A permit writer conducts a reasonable potential analysis using effluent and receiving water data, and the findings are included in the permit issuance documentation, which can be viewed on the Wastewater Program's discharge permit database.

The Agency is also actively working with the Town of St Johnsbury on minimizing overflows from the combined sewer system that is an additional source of nutrients and pathogens to surface waters. A combined sewer system collects sewage and stormwater in the same pipe and directs it to the WWTF. Although the system works well in dry weather, the runoff from strong storms or snowmelt overwhelms the combined system. To prevent sewage backups into basements or onto roadways, some of the untreated wastewater is diverted into the Passumpsic and Sleepers rivers via outfall pipes. The Town of St Johnsbury has produced a Long Tern Control Plan that outlines steps to address combined sewer overflows (CSOs), stating that "the improvements to the combined sewer collection system identified in this report will resolve combined sewer overflows, hydraulic capacity issues, undersized piping, inadequate maintenance access, alignment problems, and aging infrastructure deficiencies." The plan also includes alternative improvements and recommendations and "a schedule, construction costs, and total project costs with a review of potential funding scenarios for the project." The State of Vermont issued a 1272 order for St Johnsbury on 7/26/2022 with a schedule of activities planned to eliminate or abate CSOs and annual reports to summarize Long-Term Control Plan activities completed each year. Information on the Long-Term Control Plan is available in the St Johnsbury folder of the Wastewater Program's discharge permit database that includes additional information regarding specific 1272 order, Long-Term Control Plans, and CSO annual reports. A summary of work completed by facilities and expected upgrades to meet WWTF permits is located at the end of this section. Permit issuance documentation can be viewed on the Wastewater Program's discharge permit database.

In addition to the improved WWTF functioning achieved through Nitrogen Optimization Plans and CSO Long-Term Control Plans, large contributions of commercial discharges to facilities now receive pretreatment. The Wastewater Management Program issues permits under the Federal Pretreatment Permit program for certain industrial and commercial discharges to municipal WWTFs. The conditions of the DEC pretreatment permit help minimize the potential that industrial or commercial discharges will interfere with the operation of the treatment facility, resulting in the release of untreated wastewater to the environment. There are currently no pretreatment permits that discharge to Passumpsic basin WWTFs.

## *Technical and Financial Assistance*

The DEC and partners assist municipalities in discharge permit compliance by providing access to funding and technical assistance. Vermont provides loans and grants to supports municipal WWTF and associated infrastructure upgrades through the Clean Water State Revolving Fund, Vermont Pollution Control State Revolving Fund, and the Vermont Engineering Planning Advance Program; and grants via the Vermont Pollution Control Grants and the Clean Water Fund (created via Act 64: Vermont Clean Water Act). The US Department of Agriculture also provides loans via USDA Rural Development Water and Environmental Loans and Grants.

The DEC Wastewater Management Program works cooperatively with local organizations, such as Vermont Rural Water Association and Vermont Energy Investment Corporation, to facilitate technical assistance related to optimization of nutrient removal and energy efficiency at WWTF.

The DEC and partners are also available to assist municipalities with asset management planning, which includes needed upgrades and timeline as well as funding sources and deadlines. Without a plan, facilities tend to delay upgrades and therefore Clean Water State Revolving Fund funding upgrades until required by permits. As permit reauthorization occurs at the same time for all facilities within the same basin, they may end up competing for a set amount of annual funding. With an asset management plan in place, municipalities could plan over a longer time period as well as multiple Clean Water State Revolving Fund cycles.

**Table 9. Summary of permit requirements for the wastewater treatment facilities in the Passumpsic River basin. To view the permits, see the Vermont's Wastewater National Pollutant Discharge Elimination System Permit webpage.**

| Facility (Permit ID) | Permit Expiration | Permitted Flow (MGD[1]) | Current Percent of Flow[2] | number of CSOs | Treatment Type | Receiving Water |
|---|---|---|---|---|---|---|
| Danville 3-1235 | 9/30/2021[3] | 0.06 | 59% | 0 | Aerated lagoon | Water Andric |
| Lyndon 3-1111 | 9/30/2021[3] | 0.75 | 18% | 0 | Activated sludge | Passumpsic River |
| Lyndonville Water Treatment Plant 3-1325 | 12/31/2024 | .02 | 57% | N/A | Settling Tank | East Branch Passumpsic River |
| St. Johnsbury 3-1290 | 3/31/2023 | 1.6 | 70% | 15 | Rotating biological contactor | Passumpsic River |
| Weidmann Electrical Technology 3-1184 | 9/30/2024 | 0.250 | 94% | N/A | Dissolved Air Flotation | Passumpsic River |

[1]MGD = Million gallons per day – annual average

[2]Percentage was calculated using the average monthly flows (Effluent Gross Value) for the period 1/1/2023 to 12/31/2023.

[3]Permit under Title 3 administrative continuance until renewed

## *Facility–specific information*

The WWTF upgrades and associated projects described below, as well as those in the Priority List of Vermont Waters, will provide water quality benefits by addressing the Long Island Sound Dissolved Oxygen TMDL and associated implementation plan. In addition, any WWTF and infrastructure upgrades or other wastewater management projects within a DEC-specified distance upstream of a swimming hole identified as an existing use (existing use lists are found on the Passumpsic Basin Planning Webpage) would also benefit water quality. The projects are also required to uphold Vermont's Anti-Degradation Policy.

The Water Investment Division will consider each of the wastewater treatment facilities and associated infrastructure upgrades listed above that have municipal support for future drafts of the Project Priority List articulated in the DEC's Intended Use Plan. Please see the Intended Use Plan for the list of Passumpsic basin municipalities with projects currently on the Project Priority List.

### Danville

The Danville WWTF is a small, two-cell aerated lagoon facility discharging to a receiving stream of limited assimilative capacity. The WWTF has influent screening and ultraviolet disinfection. A waste management zone extends from the outfall one-mile downstream. Owing to the small size of the receiving water, this facility is required to monitor receiving water flow during summer months, and release effluent only in such quantities as can be assimilated, based on measured effluent concentrations for key pollutants.

The Town is going through the Clean Water State Revolving Fund process to upgrade the facility and a Preliminary Engineering Report (PER) has been drafted.

### Lyndon

The Lyndon WWTF was upgraded in 2012 from extended aeration to complete mix activated sludge with anoxic selectors. The upgrade included new mechanical fine-screens, grit removal, and centrifugation to de-water sludges, to improve operational and cost efficiency. The facility participated in the Long Island Sound TMDL nitrogen treatment optimization study. As noted in this study the plant staff at Lyndon have been experimenting with cyclic aeration to reduce nitrogen without having to use a recycle pump and this approach has shown good nitrogen removal over extended periods, except for colder temperatures (JJ Environmental, 2015).

### Lyndonville Water Treatment Plant

The Lyndonville Water Treatment Plant receives water from a wellfield and is treated by a pressure carbon filtration system and chlorinated before distribution. Backwash to remove solids accumulated on the filters or when carbon filters are replaced and water from cleaning the filter

vessel are discharged to a settling tank. Sediment settles out and the water is tested and discharged once it meets permit requirements.

### St. Johnsbury

The St. Johnsbury facility is actively pursuing remediation of CSO outfall points as required by order of the Department, under authority of 10 V.S.A.§1272. The municipality developed a Long-Term Control Plan (LTCP) in 2021 which contained a schedule of projects the City will undertake in order to address the occurrence of CSO events. A new 1272 Order was issued in 2022 with the schedule of activities planned to eliminate or abate CSOs and annual reporting requirements to summarize LTCP activities completed each year.

The St. Johnsbury wastewater treatment facility has completed numerous upgrades over the past couple of years. In 2019, the anaerobic digesters were refurbished to produce heat and reduced the need for supplemental fuel oil in the winter. The Rotating Biological Contactors are being rebuilt and have had VFDs installed for power conservation. The facility has been testing a screw press for processing solids and a permanent screw press is expected to be installed next year.

### *PFAS Monitoring*

As part of a statewide investigation of potential conveyors of PFAS, DEC is supporting a sampling program for wastewater treatment facilities. As part of implementing the DEC PFAS Road Map, $1.25 million dollars of American Rescue Plan Act funding has been dedicated for a two-phased project to (1) quantify PFAS in municipal wastewater discharges across the State and (2) focus resources on identifying and reducing or eliminating PFAS sources in select communities. DEC is partnered with Weston and Sampson to conduct quarterly influent and effluent sample collection at each of Vermont's 94 direct discharge municipal WWTFs and analysis for PFAS utilizing current analytical methods. This first phase of the project started fall 2023 and is expected to take place over one year. Upon completion of phase 1, the information obtained will be used to select municipalities for additional PFAS investigation. The second phase will involve collaboration with DEC and municipal officials to plan and conduct targeted collection system sampling for PFAS analysis to identify sources and mass loading to municipal WWTFs.

## Soil-Based Wastewater Disposal Systems (Septic Systems)

In Vermont's mostly rural landscape, the majority of wastewater is treated through soil-based wastewater disposal systems. If not installed appropriately, wastewater may reach groundwater that enters surface waters or be discharged to surface waters.

Since 2007, the State of Vermont has had regulatory jurisdiction over the design, permitting, and installation of all new wastewater systems and potable water supplies including septic systems. All

new wastewater systems and potable water supplies under 6,499 gallons per day must obtain a Wastewater System and Potable Water Supply Permit

Larger systems of 6,500 gallons per day and over are permitted through Vermont's Indirect Discharge Program, a NPDES permit. Indirect discharge systems are soil-based disposal systems, which also include primary treatment, and may include additional secondary or tertiary treatment levels depending on discharge requirements. Water quality related indirect discharges are monitored. Systems can be municipality or privately owned.

### *Financial and Technical Assistance*

For residential systems under 6,440 gallons, state financial assistance is available to qualifying homeowners for system upgrades and until 2024 includes American Rescue Plan Act funding. Technical assistance and education are provided by Town Health Officers, including investigating citizen concerns about failed septic systems.

The WSMD Lakes and Ponds Management and Protection Program and the Drinking Water and Groundwater Protection Division support outreach to homeowners during neighborhood gatherings organized by partners. At these wastewater workshops, homeowners learn about the options for a well-functioning onsite wastewater system and good maintenance practices for wastewater systems on lakeshores. Lakes in the basin that would benefit from wastewater workshops are larger populated lakes like Joes Pond and Newark Pond. Communities where residential development is dense and adjacent to waterways such as Concord or East St Johnsbury may also benefit from these workshops, and other interested river and lake communities are encouraged to participate. More information can be found at the Wastewater Workshop website.

### *Village Wastewater Solutions*

Many historic villages do not have municipal treatment facilities. Closely spaced on-site septic systems adjacent to waterways can be the source of elevated levels of contamination. Failed or poorly functioning systems can contribute *E. coli*, phosphorus, or nitrogen to surface waters. Additionally, failed systems can cause cross-contamination of nearby drinking water wells. Momentum has been growing in rural villages to explore options to deal with concerns about pollution from septic systems and the need for economic growth in village centers that is limited by the lack of community scale shared wastewater systems.

DEC provides direct funding and technical assistance to small communities without municipal treatment to help evaluate and plan for wastewater needs. It is anticipated there will be a steady demand by small communities for wastewater evaluations and planning in the coming years. Small lots and older on-site sewage systems, without municipal treatment infrastructure, re-development or the re-sale of property may require expensive upgrades. Another factor is the economic viability

of small communities which cannot support commercial or residential growth due to the lack of wastewater treatment options. Alternative treatment systems are available to communities not wishing to build large waste treatment facilities, including several advanced technologies for small community scale systems that have been approved for use in Vermont.

Resources available for assisting municipalities include the Clean Water State Revolving Fund, as well as Village Water and Wastewater Initiative American Rescue Plan Act grant funding. The town of Burke is included in the Clean Water State Revolving Fund Project Priority List articulated in the FFY24/FFY25 DEC's draft "Intended Use Plan" as developed by the Water Investment Division for the West Burk Village Wastewater project.

Assistance in planning for on-site systems as well as connections to existing sewer is also available through the Vermont Engineering Planning Advance Program. The loan program is available to municipalities without existing municipal water or sewer systems for conducting a feasibility study for community-based drinking water and/or wastewater solutions. Consulting engineers assess the town's needs and goals offering treatment options.

To support towns with limited staff for supporting wastewater studies, Vermont has formed an interagency Village Wastewater Solutions Initiative. The program offers the following resources:

- Organizing Village Wastewater Solutions
- Wastewater Solutions for Vermont Communities

Northern Border Regional Commission grants are also available to Passumpsic basin municipalities for addressing wastewater. A current collaboration between DEC and partners and the villages of Wolcott, East Burke, and West Burke to identify cost-effective wastewater solutions is being supported through the grant. This wastewater solutions project is expected to provide a model for other villages throughout Vermont.

## D. Natural Resources

Forests, lakes, ponds, rivers, floodplains, and wetlands are all examples of natural systems that provide continuing benefits both socially and ecologically. Natural resource restoration and protection projects help to prevent and reduce nutrient and sediment pollution, improve flood resiliency by mitigating flood hazards, enhance habitat function, and support Vermont's outdoor recreational opportunities. These projects are also the most economical and have long-term benefits with little to no maintenance requirements. Restoration and protection of natural systems offer a

cost-effective, long-term means to mitigate water quality and the effects of climate change and enhance the ecosystem services - flood control, wildlife habitat, filtration of pollutants - these natural resources provide.

While Agency regulatory programs protect natural resources, the Agency's also works to support landowner interest in natural resource protection and restoration and depends on partners to provide some of this assistance.

## Rivers

In response to historic intensive channel management, floodplain and riparian corridor encroachments, and watershed-wide land use and land cover changes, most Vermont rivers are actively adjusting their shape, size, and course as they seek to re-establish equilibrium (i.e., balance). Human activities can prevent or disrupt this balance by changing flow inputs to the channel (e.g., deforestation, increasing impervious surfaces and runoff, or water withdrawals) or by changing the sediment regime (e.g., dams, dredging). Legacy and present-day impacts, such as development within riparian corridors, channel straightening, berm and dam construction, removal of riparian vegetation, and construction of undersized crossing structures, have contributed to stream instability state-wide. A key consequence of these activities is the loss of resilience and the ecosystem services provided by rivers that fully achieve dynamic equilibrium. In the Passumpsic basin, loss of river equilibrium is a driver of the reduced geomorphic conditions along the Water Andric, Sleepers River, South Wheelock Branch, Millers Run and lower portions of the East and West Branches of the Passumpsic River. These conditions increase the risk for infrastructure damage and increase sediment movement and reduce resiliency and the quality of aquatic habitat.

Improving all forms of connectivity, upstream-to-downstream and river-to-floodplain, encourages river equilibrium. Enhanced equilibrium will also help to achieve climate resilience through mitigating impacts of increased runoff and streamflow (see Climate Change section). Tactical basin planning engages local, regional, and federal partners in the development of strategies needed to accelerate practices to move toward equilibrium and increase river connectivity to meet the state's clean water goals. The ANR's strategies to enhance stream stability and storage include implementing projects such as active in-stream restoration, the removal of constraints, the protection of natural processes through easements, floodplain restoration to reduce channel incision, dam removals, and other efforts that move the river and floodplain toward equilibrium conditions. The Rivers Program supports partners in project identification and prioritization through the use of stream geomorphic assessments as well as the Functioning Floodplain Initiative tool. The Rivers Program and ANR provide technical support and financial assistance for project implementation as well.

## *River Corridor Plans*

A River Corridor Plan (RCP) is a synthesis of the physical data collected during Phase I and II Stream Geomorphic Assessments (SGAs) based on protocols and guidelines developed by the Rivers Program. These plans identify causes of channel instability and make recommendations for restoration and protection projects. All SGAs and RCPs can be found at: Stream Geomorphic Assessment - Final Reports, and Passumpsic basin plans are linked in Table 10.

Rivers are in a constant balancing act between the energy they produce from the slope of the channel, and the volume and weight of the moving water and the energy they expend to carry water, sediment, and debris downstream. A change in any one of these factors will trigger adjustments of the other variables until the river system comes back into equilibrium. These changes can be caused by natural events such as storms and by human activity such as channel manipulation. The impact of these changes may be seen immediately and for decades after the activity occurred.

The legacy from Tropical Storm Irene in 2011 and other large flood events like those in July 2023 will be felt for years to come. While such flooding impacts are unlikely to be fully mitigated, the goal of managing toward, protecting, and restoring the equilibrium condition of Vermont rivers is to lessen or avoid conflicts between human investments and river dynamics in a manner that is technically sound, and both economically and ecologically sustainable. In addition, it will help to mitigate impacts of increased runoff and streamflow from climate change. The town of Lyndon has been frequently impacted by flooding events and is in the process of evaluating alternatives to address flooding through a Lyndon Flood Mitigation Study.

Where funding, local support, and interest exists, priority projects and objectives identified in RCPs and SGAs should be pursued. Priority sub-watersheds include the East and West Branches of the Passumpsic River, Millers Run, South Wheelock Branch, the Sleepers River, and Water Andric.

**Table 10. Stream Geomorphic Assessments and River Corridor Plans are available for many of the Passumpsic basin's major river segments and sub-watersheds.**

| River | SGA Phase 1 Completed | SGA Phase 2 Completed | RCP Completed |
|---|---|---|---|
| East Branch Passumpsic | 2009* | 2009* | 2009* |
| West Branch Passumpsic | 2010* | 2010* | 2010* |
| Moose River | 2009 | 2009 | |
| West Branch and Sutton River | | | 2014 |
| Millers Run | 2009* | 2009* | 2009* |
| Dish Mill Brook | | 2014* | 2014* |
| Lower Passumpsic Tributaries | | 2014* | 2014* |

* indicates both SGA phases were completed in the same report.

## River Restoration and Conservation

Active river restoration can include, but is not limited to, the reconnection and improvement of floodplains through berm removal, dam removals, woody buffer plantings (trees and shrubs), in-stream wood additions, head-cut stabilization, encroachment removal, and upgrading structure size. The Connecticut River Conservancy has worked with NorthWoods Stewardship Center and the Passumpsic Valley Land Trust (PVLT) restore floodplain forests on 20.8 acres of land owned by the Passumpsic Valley land Trust. Nearly all of the PVLT lands have been planted and so now partners are looking to expand outreach efforts to increase buffer planting on privately owned riparian lands in this watershed.

Scientific research also strongly supports the value of planting trees and shrubs along stream and lake shorelines for both water quality and wildlife habitat. Shoreline vegetation filters and cleans polluted runoff from floodwaters and from uphill land uses, provides shoreland and shallow water habitat, stabilizes banks, and increases lake and river aesthetics. However, regional tree stock shortages as well as difficulties in funding and implementing invasive species management in the riparian zone can hamper buffer implementation. As efforts to increase inventory ramp up, this plan recommends partners continue to evaluate and implement innovative buffer solutions in coordination with AAFM, DEC, FWD, US Fish and Wildlife Service, and other agencies active in this area. Appropriate methods are context-dependent but might include riparian agroforestry, hydroseeding, passive restoration, and invasive species management and novel management techniques.

In addition, ANR prioritizes river reaches that are identified as high priority sediment and nutrient storage areas for conservation. One option for protection, outside of land acquisition, is purchasing river corridor easements to avoid future encroachment and flood damage as well as to restrict channel management activities. River Corridor Easements protect rivers from channel management activities like armoring and straightening that can degrade the river and functions of a river corridor. As of 2024, one River Corridor Easement has been purchased on the Millers Run covering 171 acres.

## Process-based Restoration

Process-based restoration is defined by Beechie et al. (2010) as work that "aims to reestablish normative rates and magnitudes of physical, chemical, and biological processes that create and sustain river and floodplain ecosystems (e.g., rates of erosion and deposition, channel migration, growth and succession of riparian vegetation)." One area that process based restoration has been focused on restoring is the incorporation of wood back into river systems through different formats to help generate those processes that help move a stream toward equilibrium. Large woody material is a critical component of rivers. It improves fish habitat, stream stability, floodplain connection, nutrient processing, and sediment storage, but it is generally lacking in most Vermont streams due to

past and present river management practices to accommodate land uses such as logging, agriculture, and urban and residential development.

Likewise, the long-term absence of beaver populations from many stream basins due to past overharvest has likely contributed to more streams becoming single-threaded, flashy, and incised than would have historically existed on the landscape. Strategic wood addition, beaver dam analog construction, and post-assisted log structures are examples of low tech process-based restoration techniques meant to initiate stream channel evolution toward a more complex, connected, resilient configuration where sited, designed, and implemented appropriately. Process-based restoration should move the stream toward becoming self-sustaining, such that over time additional work to maintain these or other created structures is not needed to achieve the goals of the project.

Process-based restoration has been focused on the implementation of strategic wood addition (SWA) efforts in the Passumpsic River Basin which has been completed on:

- West Branch Moose River – Completed SWA on 3.9 miles of stream in 2021
- East Branch Moose River – Completed SWA on 0.8 miles in 2021 and 0.4 miles in 2022
- East Branch Moose River tributary – Completed SWA on 1.1 miles in 2021
- Line Brook – Completed SWA on 1.2 miles in 2021
- Cold Brook – Completed SWA on 1 mile in 2022
- James Brook – Completed SWA on 1.3 miles in 2022
- Umpire Brook – Completed SWA on 0.5 miles in 2022
- Bog Brook – Completed SWA on 0.4 miles
- Rock Brook – Completed SWA on 0.6 miles
- Coles Pond outlet – Completed SWA on 0.6 miles
- Steam Mill Brook tributary – Completed SWA on 0.5 miles
- Stream Mill Brook – Completed SWA on ~2 miles

In addition to these, Weir Mill, Bog (Moose tributary), Mathewson and Calendar Brooks were scouted and determined that SWA was not appropriate. These SWA efforts have largely been completed on state lands or lands with state access easements but there is interest among partners to begin to work with private landowners where SWA is appropriate. Viable projects can be identified by targeting initial field assessments on streams within that adhere to the general stream slope and width recommendations of the Vermont Rivers Program or FWD strategic wood policy. A further layer of prioritization focusing on B(1) fishing candidate streams would add wildlife co-benefits and potentially help leverage other funding sources for this work. For clean water funding consideration, partners should consult early with the Rivers Program, the Fish and Wildlife Department and other trained partners to collect appropriate field data to assess whether a project has a high probability of providing water quality benefits. Additionally, training and workshops on assessment and

implementation of this work are needed to grow the knowledge base required to increase implementation.

In addition to SWA projects there is interest among partners in other process-based restoration techniques such as beaver dam analogs that may help to both reduce nutrient loading, improve fish and wildlife habitat, and slow surface runoff and reduce flood damages. These techniques have not yet been widely implemented in the Passumpsic basin, but there is a growing interest in this work among partners as funding opportunities expand (e.g., Natural Resource Conservation Service, enhancement grants, Upper Connecticut River Mitigation and Enhancement Fund), regional partners share their expertise (e.g., Vermont Land Trust, The Nature Conservancy, and Trout Unlimited), and successful project examples become more common in Vermont (e.g., strategic wood addition in brook trout streams of the Memphremagog basin, beaver dam analogs on The Nature Conservancy's Hubbardton River Clayplain Preserve).

This plan does not prioritize process-based restoration at the sub-watershed scale, but when projects are proposed that improve both water quality and habitat and are supported by both FWD and the Rivers Program, funding should be prioritized.

### *Aquatic Organism Passage Workgroup*

Bridges and culverts convey the flow of water under transportation corridors. Transportation corridors include federal, state, and local roads, logging and forest roads, private roads and driveways, and railroads. Most of this infrastructure was built before engineers and scientists fully understood the balance required for managing sediment and flow to protect stream channels (and adjacent developed lands). The correct sizing and placement of bridges and culverts plays a significant role in protecting water quality in the basin while also protecting infrastructure itself. Correctly sized and installed structures prevent erosion and scouring upstream and downstream, allow for the passage of fish and wildlife, and reduce impacts from flooding. Replacing structures with ones that meet the current geomorphic and connectivity standards allows fish to move among complementary foraging, spawning, thermal refuge, and overwintering habitats. Without access to essential habitat, fish diversity and abundance decline.

The US Fish and Wildlife Service has organized several partners in the Upper Connecticut River region, including the Vermont portions of the Connecticut river above the White River confluence. This group meets several times a year to identify priority culverts for retrofit or replacement to restore aquatic organism passage and improve crossing compatibility with its geomorphic setting. Finding these mutually beneficial projects can be an important strategy given the relatively large expense of crossing projects and cost share opportunities with fish and wildlife-focused or transportation-focused funding programs. The initial priority areas to identify AOP projects only included a few small portions of the Passumpsic River basin, so the group has identified only three culverts in this basin as priorities for retrofit and replacement, however due to cost or lack of local

support none of these projects are moving forward. The AOP group is planning to select the next set of priority subbasins to evaluate AOP priorites and this is expected to include a much larger portion of the Passumpsic River basin, likely including the Sleepers River watershed, and so will likely identify a number of priority AOP projects to implement over the life of this plan.

### *Dams and Dam Safety*

There are records of 65 dams of different types, sizes, and condition in the Passumpsic basin. While some dams are used to generate energy and support recreational opportunities such as boating, fishing, and swimming, dams also impede a river's ability to transport flow and sediment; cause streambank erosion and flooding problems; degrade and alter fisheries habitat; create barriers to fish and other aquatic organisms' movement and migration; alter downstream water temperature; degrade water quality; and impede river-based recreational activity.

Of the 65 inventoried dams, 35 are in-service, 7 are fully breached, two are partially breached, and 21 have been removed. The 35 active in-service and two partially breached dams may constrict the stream channel enough to reduce sediment transport, prevent lateral movement, and inhibit aquatic organism passage if mitigating actions have not been taken (e.g., fish ladder). Additional dam information can be found in Appendix A.

The Vermont Dam Safety Rules are in place to protect public safety and provide for the public good through the inventory, inspection, and evaluation of dams in the State. The Dam Safety Program administers the rules which apply to all non-power dams (dams that do not relate to the generation of electricity for public use) and all non-federal dams (dams that are not owned by the US or are subject to Federal Energy Regulatory Commission license or exemption). The rules set requirements and standards on dam registration, classification, inspection, application, and approval to construct, re-construct, alter, repair, breach, or remove a dam, as well as related standards including design standards, operation and maintenance standards, inspection standards, and Emergency Action Plans.

All dams, even small dams for backyard ponds, are significant structures that can have major public safety and environmental implications. Four of 65 inventoried dams are considered high or significant hazards (Appendix A), indicating that either direct loss of life is probable from an incident, uncontrolled release, or dam failure (high hazard) or that major property losses, disruption of critical services, and environmental losses are probable (significant hazard). Dam removals are pursued by private and public dam owners, often with the help from watershed groups and partners. There have been several dam removals in the Passumpsic Watershed including the removal of the East Burke Dam in 2017.

Not included in the dam inventory are a series of 15 weirs that are in the Sleepers River watershed that were installed to support monitoring flow in this study watershed not managed by the US Geological Survey. In many ways these weirs act as dams, impacting rivers in a similar way. Several of these are still in use by USGS for monitoring flows, however 11 of the weirs no longer serve a

function and are priorities for removal. Several partners in the watershed have been meeting to work on efforts to remove these weirs including the US Fish and Wildlife, the Caledonia County NRCD, Trout Unlimited, Department of Environmental Conservation and Vermont Fish and Wildlife. The CCNRCD has received funding for the design to remove the weir on Houghton Brook.

There are several other dams in the watershed that are priorities for removal. The Institute Dam in Lyndonville is rated as a high hazard dam and is being considered for removal. The Fairbanks Morse Dam in Danville is surrounded by USGS weirs but is a priority for removal if landowner support can be secured, and this, along with USGS weir removal would open up a large amount of river for aquatic organism movement. There are several dams that were built to create reservoirs used as water supplies by the Village of Lyndonville but are no longer in use. Two of these dams, the Fay Young dam and the Upper Ice Pond dams are priorities for removal, although the removal is expected to be costly relative to the water quality benefits given the small watersheds that would be reconnected by these dam removals.

Opportunities for restoration may exist at other sites upon further discussion with dam owners as the risk to public safety and ownership liability associated with aging and deteriorating dams becomes more evident. Dam owners are encouraged to contact the Vermont Dam Safety Program and their Watershed Planner if they are interested in discussing dam removal. Dam removal is a priority basin-wide where the removal will result in restoration of stream equilibrium and habitat, fish passage, and sediment reduction.

### *FEMA Maps*

The Federal Emergency Management Agency (FEMA) is currently updating the Flood Insurance Rate Maps in Vermont for the National Flood Insurance Program. This will be the first map update for many towns since the 1970s or 1980s. This new update will cover the entire state in stages and may become effective in some counties as soon as 2025 as part of FEMA's Risk Mapping, Assessment, and Planning program. Passumpsic basin towns had initial discovery meetings with FEMA in 2019. During the meetings, stakeholders, including FEMA, state, and community officials, discussed areas of flooding concern and project goals, milestones, and products. Draft updated maps for most counties in the basin may be ready for town review by fall 2024, with a target date for review by the public in 2025 and becoming effective in 2027.

Most high-risk flood hazard areas in the basin will be mapped as Zone A, using a new Baseline Engineering strategy that combines computer modeling and high-resolution ground elevation data (lidar). Other areas with existing detailed flood studies will be labeled as Zone AE, with the older studies aligned with current topography. The new Flood Insurance Rate Maps will include aerial photographs that show houses and roads.

Flood Insurance Rate Maps are the basis of floodplain regulations and the National Flood Insurance Program. When the new maps go into effect, FEMA requires that town bylaws meet current

standards for participation in the National Flood Insurance Program. To support towns in the timely adoption of updated bylaws, DEC provides a model bylaw that meets or exceeds the National Flood Insurance Program requirements, addresses river corridors consistent with Act 250 review, and ensures municipal eligibility for the maximum amount from the Emergency Relief and Assistance Fund. For ease of adoption in the limited time that will be available to the towns, it was designed for use as either a stand-alone bylaw or an appendix to a zoning bylaw.

The regional planning commissions, with financial and technical support coordinated by the DEC regional floodplain managers, are facilitating the planning commissions and selectboards bylaw adoption. This process also benefits from the participation of other partners in the support of meaningful community engagement in consideration of public safety, equity, and the multiple benefits of functioning river corridors and floodplains. The DEC Rivers Program details the FEMA mapping process in Vermont online. Although DEC supports a town's adoption of enhanced river floodplain protection, the current update to a town's bylaw is a time-sensitive priority. As such, this TBP recommends the regional planning commission perform targeted outreach to communities to adopt model flood hazard bylaws as part of the map update process. Flood hazard bylaw updates reduce river and infrastructure conflicts, ultimately mitigating downstream erosion and pollutant transport by increasing stream lateral (side to side) and longitudinal (upstream to downstream) connectivity.

The Northeastern Vermont Development Association has developed a flood hazard regulation review checklist and reviewed municipal bylaws for towns in the Passumpsic Basin that participate in the NFIP program. Based on this checklist review some communities have minimal updates, while other communities have not updated by-laws for many years, and in these cases, bylaws may require more extensive updates to remain compliant with the minimum NFIP standards as part of the map update process. The communities that participate in the NFIP will have two years to update their flood hazard bylaws. If regulations are not adopted by then, the residents and business owners of that municipality will no longer be able to obtain flood insurance through the NFIP.

## Lakes

A lake's water quality is impacted by human activities and the land uses on the immediate shoreland and farther up into the watershed. The loss of native vegetation at the shoreline, the locations of roads, the development pressures around the shoreline and into the watershed, and activities such as agriculture and forestry all contribute to overall lake and pond health.

Preventing and mitigating water quality degradation, preserving and enhancing lake habitat and shoreline stability and ensuring recreational uses of lakes and ponds are priorities for the basin. Recommendations below are based on the VT Inland Lakes Scorecard status of lakes and ponds, and feedback from the Lakes and Ponds Management and Protection Program (LPMPP) and basin stakeholders.

## *Protecting and Improving Lakeshore Condition*

Shoreland disturbance contributes to degraded lake water quality and lakeshore habitat. The Shoreland Protection Act (Chapter 49A of Title 10, §1441 et seq.) regulates shoreland development within 250 feet of a lake's mean water level for all lakes greater than 10 acres in size. The intent of the Act is to prevent degradation of water quality in lakes, preserve habitat and natural stability of shorelines, and maintain the economic benefits of lakes and their shorelands. The Act seeks to balance good shoreland management and shoreland development.

In 2022, the Vermont Lakes and Ponds Management and Protection Program released new guidance to help property owners protect and restore lakeshore properties. The Shoreland Best Management Practices guidance is comprised of multiple Best Management Practice documents. Each document highlights different shoreland management activities to improve water quality and the health of lakeshore habitat. Examples of activities include planting native trees and shrubs, installing rain gardens to absorb runoff, improving driveways and pathways, and creating no-mow zones. Small practices can be implemented by landowners directly, but larger projects may require support from local partners and additional clean water funding.

The Lake Wise Program encourages lakeshore owners to implement best management practices that improve and protect lake water quality conditions and habitat. The program awards lake-friendly shoreland properties including state parks, town beaches, private homes, and businesses. Lake Wise assessments review shoreland practices for their benefit to water quality and wildlife habitat and suggest actions if improvements are needed. Lakes with a Fair or Poor shoreland score will benefit from implementing Lake Wise Program best management practices.

One lake in the basin greater than ten acres has a poor shoreland habitat condition rating from the VT Lake Scorecard (Joes Pond), and 8 are rated fair. Of these lakes, five were identified as potential priorities for Lake Wise assessments because of their shoreland condition (and three with increasing nutrient trends) and number of lakeshore residents: Joes Pond, Coles Pond, Bald Hill Pond, Center and Newark Ponds. The Caledonia County Natural Resources Conservation District has been working with a group of interested Joe's Pond residents on conducting outreach for and completing Lake Wise Assessments and has worked with landowners to implement three projects that were identified through these assessments.

Lake users interested in becoming involved in the health of their favorite lake or pond can find information on the VDEC Lakes and Ponds website as a first step to moving toward a healthier lake or pond.

## *Lake Watershed Action Plans*

Lake Watershed Action Plans (LWAPs) are assessments to identify pollution sources in the lake watershed that result in water quality and habitat degradation. Vermont DEC Lakes and Ponds Management and Protection Program uses the following metrics to determine priority lakes for Lake Watershed Action Plans: Increasing Phosphorus Trends, Disturbed Shoreline/Watershed, and an engaged Lake Association or other watershed group. Sources of data for these metrics include data from the VT Lake Scorecard, Next Generation Lake Assessment Reports, Lake Wise and AIS program Engagement. The LWAPs result in a prioritized list of projects and strategies to address the sources of pollution and habitat degradation identified in the assessment. The plan may also contain recommendations to preserve natural features and functions, encourage use of low impact green stormwater infrastructure, and maintain the aesthetic and recreational uses of lakes. To date no lakes in the Passumpsic Basin have completed LWAPs or have received funding to develop an LWAP.

Joes Pond is a possible LWAP candidate in the basin because of increasing nutrient trends, poor condition shorelines, and moderately disturbed watersheds. However, the intensity of development along the shoreline mean that there may not be clear opportunities for projects that an LWAP is likely to identify. In addition to this, the larger watershed for Joes Pond also makes the LWAP approach challenging for completing assessments and following up on implementation. If ongoing efforts to complete Lake Wise assessments generate more local interest, and local communities express a commitment to implement practices from a LWAP for Joes Pond, then the priority for completing an LWAP for this waterbody may increase to make this a candidate for state LWAP funding.

## *Cyanobacteria*

Cyanobacteria, also known as blue-green algae, are naturally found in fresh water in the U.S., and in Lake Champlain and other Vermont waters. Cyanobacteria grow well in water that has high amounts of nutrients like phosphorous and nitrogen. Cyanobacteria can multiply quickly to form surface scums and dense populations known as blooms, especially during the warm days of late summer and early fall. Some types of cyanobacteria can release natural toxins or poisons (called cyanotoxins) into the water, especially when they die and break down.

Since 2003, the Lake Champlain Committee has trained citizen volunteers to monitor for cyanobacteria at lakeshore locations. Volunteer monitors, along with staff from the Vermont Department of Health and LPMPP, file weekly online reports that are then displayed on the Cyanobacteria Tracker Map. The program helps citizens, and health, environmental, and recreational officials, assess the safety of our beaches. It also provides important data to better understand when

and why blooms occur. In 2024, two Passumpsic basin lakes were evaluated at least once for cyanobacteria blooms (Joes Pond and Coles Pond), and both had reported water quality conditions of generally safe on all dates monitored. Annual reports on long-term chemical and biological monitoring including cyanobacteria blooms are available on the LPMPP website.

### *Preventing Aquatic Invasive Species*

Aquatic invasive species can affect water quality by degrading shoreline habitat, generating imbalance in lake food webs, and altering chemical and physical factors important to aquatic systems (e.g., hydrology, nutrient transport, and oxygen concentration). Of the 11 lakes and ponds assessed for AIS in the basin, only Lyford Pond received a poor score for AIS.

New AIS introductions occur mainly in waterbodies that have launch sites for motorized watercraft, are near infested waters, and lack spread prevention programs. Incoming motorboats from AIS infested waters are a high risk for introducing AIS in and on motors, propellers, trailers, and boating equipment. Vermont Fish and Wildlife Department (FWD) manages seventeen lake access areas in the basin. The VT Public Access Greeter Program, Vermont Invasive Patrollers, and Vermont Invasive Patrollers for Animals, are spread prevention programs that incorporate AIS identification training, surveying and monitoring, watercraft inspection, and decontamination programs. VT Public Access Greeter Programs are supported by DEC's Aquatic Nuisance Control Grant-in-aid funding. Greeters interact with boaters at boat access areas, inspect watercraft, identify and remove any suspicious matter, and collect and report AIS data. Greeters also distribute educational material. Vermont Invasive Patrollers Program trainings are offered on an annual basis.

The Aquatic Nuisance Control Grant-in-Aid Program and provides financial assistance to municipalities and agencies of the state for aquatic invasive and nuisance species management programs. Joes Pond is the only lake in the basin with an active Greeter program. A map of active greeter and control efforts is available online.

## Wetlands

Wetlands cover about 5% of the basin and are important for safeguarding many of its high-quality surface waters. As recently as the 1950s, wetlands were seen as obstacles to development, agriculture, and transportation, and consequently, were systematically drained and altered. These losses and alterations diminish the important ecosystem services provided by wetlands such as sediment and nutrient attenuation, wildlife habitat, and flood water storage. Protecting the remaining wetland resources is an important strategy in the basin. Additionally, restoring degraded wetlands is

essential to improving water quality. Wetland conservation and restoration and identifying sites with the greatest potential for improving water quality are priority recommendations.

## *Wetland Assessment and Protection*

The Wetlands Program regulates wetlands in accordance with the Wetlands Rules which are focused on protecting wetland functions and values. The Program also monitors and assesses wetland conditions. The Program relies on wetland mapping to help preliminarily identify the locations of regulated wetlands (Class II and Class I). Enhanced wetland mapping is being developed by the Program and will be completed for the Connecticut River Basin by the end of 2025. Current maps can be found at Wetland Inventory Map.

Enhanced protection, in the form of a Class I wetland determination, can be afforded to wetlands determined to be exceptional or irreplaceable in their contribution to Vermont's natural heritage, based on their functions and values. One wetland in the basin, Victory Bog Wetlands Complex has been identified as a candidate for Class I assessment and support for reclassification.

This plan recommends conducting these wetland assessments and evaluating community interest in reclassification for qualifying wetlands, including the Victory Bog Wetlands Complex. Stakeholders are encouraged to reach out to their basin planner and Wetlands Program staff for technical support to research and submit Class I wetland designation petitions for review, including for additional wetlands not mentioned here which may qualify.

## *Wetland Restoration*

Wetland restoration is the process of returning a degraded wetland to an approximation of its pre-disturbance condition. The United States lost over half of its wetlands through ditching and filling between 1780 and 1980, and Vermont has lost as much as 35 percent. While conservation and protection of wetlands are critical for preventing continued loss of remaining intact wetlands, wetland restoration is essential for rehabilitating those that have historically been degraded or lost. Clean water goals for wetland restoration include assessing areas of degraded and prior converted wetlands and areas of hydric soils for restoration potential and implementing restoration as sites and opportunities are identified. This plan recommends that wetland restoration and conservation be explored where water pollution reduction and flood protection is evident.

Recommendations for wetland restoration can be found in Stream Geomorphic Assessments and River Corridor Plans (Table 10).

Wetlands can also be protected through easements or other conservation programs that restrict certain uses within the eased area. Such conservation programs include the Farm Service Agency's Conservation Reserve Program, Natural Resource Conservation Service's Wetland Reserve Easement program, a 2020-2025 RCPP opportunity administered by the Clean Water Initiative

Program that targets smaller privately owned wetlands (10-50 acres), and Vermont's River Corridor Easement program. For the latter, VT Wetlands and Rivers Programs are developing template language so that river corridor easement footprints can be readily expanded to protect wetlands adjacent to the river corridor.

Wetland restoration and protection has the potential to reduce downstream nitrogen loading, improve water quality, reduce flooding, enhance aquifer recharge, and mitigate climate change through carbon storage. The Clean Water Initiative Program's current RCPP wetland easement program allows for limited restoration (e.g., tree planting) on smaller 10 – 50-acre wetlands, while Wetland Reserve Easements allow more intensive active restoration efforts. In small headwater and lowland streams, growing interest among multiple partners in process-based restoration techniques like beaver dam analogues and stage zero floodplain restoration is also likely to enhance wetland restoration in the basin. Due to the ongoing challenges of flooding in the town of Lyndon wetland restoration is a priority on the tributaries upstream of this community.

## Forests

Forest lands cover approximately 77% of the Basin. As the dominant land cover, forests are important for safeguarding many high-quality surface waters. Yet, nutrient runoff can and does originate from forestlands from poorly managed and legacy logging practices. Reducing runoff and erosion from forests is important to meeting the state's clean water goals. Forest management activities offer many benefits, maintaining healthy forest communities, improving wildlife habitat, addressing non-native invasive species, contributing to the working landscape economy, and remediating poor legacy road infrastructure. Improving management and oversight of harvesting activities by following the Acceptable Management Practices and providing educational outreach and technical assistance to forest landowners and land managers are basin priorities. Providing funding to implement improvement practices will grow the practice of good stewardship and water quality protection.

### *Forestry AMPs and Skidder Bridge Programs*

Acceptable Management Practices for Logging Jobs are scientifically proven methods designed for loggers, foresters, and landowners to prevent soil, petroleum products, and excessive logging slash from entering the waters of the State and to minimize the risks to water quality.

Stream crossings can have a significant negative impact on water quality. These impacts can be minimized by making sure that stream crossing structures are properly sized and installed

correctly before crossing streams with logging equipment. The Department of Forests, Parks and Recreation (FPR) and watershed partners provide portable temporary bridge rental opportunities for use during timber harvests. These "skidder" bridges reduce the occurrence of sedimentation, channeling, and degradation of aquatic habitat, allowing loggers to harvest timber in compliance with AMPs. When properly installed, used, and removed, Skidder bridges provide better protection from stream bank and stream bed disturbance than do culverts or poled fords. These reusable bridges are also economical, easy to install, and can be transported from job to job.

Specifications for building skidder bridges can be found at: Temporary Wooden Skidder Bridges. Information on the bridge rental program is found at: Temporary Bridge Rentals. These bridges should be utilized on logging projects basin-wide especially on steep slopes and areas with erodible soils adjacent to surface waters.

Additional guidance is available from FPR in the Vermont Voluntary Harvesting Guidelines to Protect Forest Health and Sustainability, and through support for local skidder bridge programs and forest land conservation efforts. FPR used Clean Water funding to re-launch skidder bridge construction and rental programs in 2023 with the assistance of conservation districts including the Caledonia County Natural Resource Conservation District.

Enhanced coordination between ANR and the US Department of Agriculture – Natural Resources Conservation Service such as the Regional Conservation Partnership Program (RCPP) has also brought additional technical and financial assistance statewide to forest landowners developing and implementing water quality improvement projects in Vermont, including buffer establishment, stream habitat and stream crossing improvement, forest trail and landings improvement, and forestry easements. After an initial grant of $16 million in 2015, this RCPP grant was extended for five years in 2020 with an additional $10 million in assistance to farmers and forest landowners. Importantly, RCPP is a standalone program from the US Department of Agriculture – Environmental Quality Incentives Farm Bill program, allowing separate caps of $450,000 for each program per landowner.

### *Use Value Appraisal Program & AMPs*

Vermont's Use Value Appraisal Program (UVA) enables eligible private landowners who practice long-term forestry or agriculture to have their land appraised for tax purposes based on the property's value for the production of forest or agricultural products rather than on its residential or commercial development value. Compliance with UVA requires that the AMPs be employed to the maximum practicable extent. If AMPs are not employed on the UVA parcel resulting in a discharge, it may affect parcel eligibility in UVA and be a water quality violation. While there is overlap between requirements of the AMPs and UVA, they should be viewed as distinct from each other. In addition, Act 146 creates a new enrollment subcategory in the Managed Forestland category called 'Reserve Forestland,' with enrollments in the subcategory beginning July 1, 2023. This change to

UVA accelerates the development of old forest conditions, and it does so in a way that preserves working lands as the primary focus of the Managed Forestland category of the UVA program. More information is available on the UVA Reserve Forestland website. County Foresters are available for consultation when questions arise about UVA, AMPs, and other practices to protect water quality.

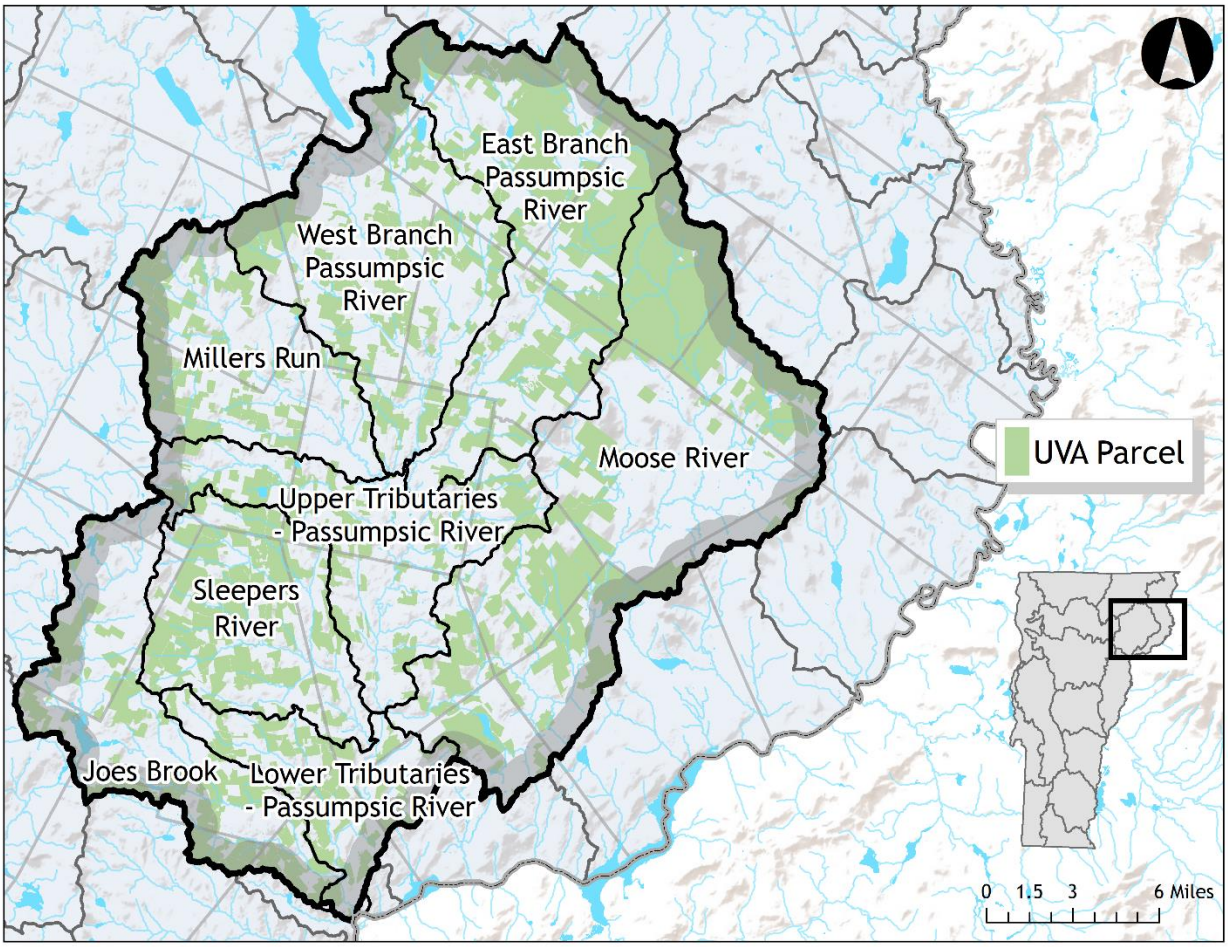



**Figure 25. Passumpsic basin parcels enrolled in the Use Value Appraisal program.**

Enrollment in the UVA program is encouraged wherever landowners express interest, and this plan particularly encourages increased enrollment in Source Protection Areas with substantial remaining UVA-eligible parcels. Major surface water source protection areas with unprotected lands are located within the Jail Branch (Barre City water system) and Stevens Branch (Montpelier Water System) sub-watersheds, whereas unprotected groundwater source protection areas are distributed across the basin. Additional voluntary forestland protections beyond UVA enrollment are especially encouraged in these surface water and groundwater source protection areas in accordance with their Source Protection Plans and via a variety of funding programs.

### *Forest Road Assessments and Management*

The ANR is in the process of assessing and prioritizing erosion issues along hydrologically connected forest roads on ANR-owned lands. State Forest roads in the basin are primarily found in Steam Mill Brook WMA, Victory State Forest, Victory Basin WMA, Darling State Park, Willoughby State Forest. These inventories will identify potential road projects which can reduce sediment and phosphorus loading to surface waters in the basin.

The ANR Private Forest Road Erosion Inventory App will become a resource for contractors and volunteers on other public and private lands in the future. The downloadable app can be used to assess and prioritize road segments in the field. Landowners may use this app to prioritize forest land projects and for supporting funding requests.

## Watershed Planning and Social Equity

Vermont's natural resources are held in trust for everyone and should be a source of inspiration and enjoyment for all. The Agency of Natural Resources is committed to ensuring that everyone living in and visiting Vermont has meaningful access and equal opportunity to participate in Agency programs, services, and activities and that everyone feels safe and welcome on Vermont's public lands.

ANR is committed to the work needed to engage our state's diverse population in shaping our shared work. As an Agency, we strive to be inclusive, both leading and supporting important work needed around diversity, equity, and inclusion – in our land management practices, in our environmental policies and permitting, and in ensuring our public processes are accessible, equitable and transparent.

Ensuring clean surface water for consumptive and recreational uses, ensuring fish caught in Vermont are safe for consumption, ensuring access to waters for all abilities and in all communities, providing open space availability in more densely populated areas, and ensuring clean water projects are equitably implemented in all communities are areas where tactical basin planning can work toward equity and environmental justice.

Focus areas for the basin include:

- Clean surface water for consumptive and recreational uses

- Safe consumption of fish caught in Vermont for subsistence anglers
- Access to waters for recreation for all abilities and economic levels in all communities
- Open space availability and access in more densely populated areas
- Equitable implementation of clean water projects in all communities

# Chapter 5 – The Passumpsic Basin Implementation Table

## A. Progress in the Basin

The previous Passumpsic basin plan was completed in 2019. A total of 43 strategies were identified in the plan. Thirty-Six (or 84%) have been implemented or are in progress by ANR and its watershed partners, and seven are awaiting action.

The TBP addresses all impaired and altered waters in the basin as well as protection needs for high quality waters. The list of strategies in the Implementation Table (Table 11) and the Monitoring and Assessment Table (Table 12) cover future assessment and monitoring needs, as well as projects that protect or restore waters and related education and outreach.

The process for identifying priority strategies is the result of a comprehensive review and compilation of internal ANR and external watershed partner monitoring and assessment data and reports. The monitoring and assessment reports include Stormwater Master Plans and stormwater mapping reports, Stream Geomorphic Assessments, River Corridor Plans, bridge and culvert assessments, Hazard Mitigation Plans, flood modeling, agricultural modeling and assessments, Road Erosion Inventories, biological and chemical monitoring, lake assessments, wetland assessments, fisheries assessments, and natural communities and biological diversity mapping.

The Clean Water Initiative Program coordinates funding, tracking, and reporting of clean water efforts for state partners, including the Agencies of Agriculture, Food and Markets; Commerce and Community Development; Transportation; and other ANR Departments (FWD and FPR), and federal partners including the Natural Resources Conservation Service and the US Fish and Wildlife Service's Partners for Fish and Wildlife Program.

The Division's reporting on financial investments made and phosphorus loads addressed occurs annually. Progress toward the 43 strategies from the 2019 plan are posted in a report card posted on the Basin 15 website.

## B. Public Participation

Public input is key to the development of this Plan and the strategies included in the Implementation Table. Public participation is sought throughout the planning process. The planning process for the Passumpsic basin kicked off in the fall of 2023 with the release of a story map and public survey. The survey and links to the story map were posted to Front Porch Forms and distributed through partner newsletters and email lists.

The primary goals of the on-line survey and web map are to provide an opportunity for stakeholders to contribute information to the planning process and to educate the community. Twenty respondents from 11 in-basin towns offered their input. 95% of respondents provided contact information to remain engaged in the planning process and 55% were interested in volunteering in some way.

Many respondents owned property with streams or water resources on them or recreate on lakes and streams in the basin. They identified development along lakes and streams, roads, lack of forest buffers, knotweed, agricultural runoff and logging as threats to waters in the Passumpsic Basin. Respondents recommended protections for Bean Brook, planting trees, conservation of river corridors, public education, and road erosion management as solutions to these water quality issues. In terms of ideas on how to get people excited about protecting our watershed respondents suggested making information on water quality easier to find, holding educational events on weekends, news stories and social media posts, websites, and town presentations. Where specific waterbodies and pollutants were identified or interest in clean water project development was expressed, the planner will coordinate with state and watershed partners to further evaluate the concern or project opportunity.

## C. Coordination of Watershed Partners

There are several active organizations undertaking watershed monitoring, assessment, protection, restoration, and education and outreach projects in the basin in coordination with the ANR. These partners are non-profit, private, state, federal, or other organizations working on both private and public lands. Partnerships are crucial in carrying out non-regulatory projects to improve water quality. The Caledonia County Natural Resources Conservation District (CCNRCD), Essex County Natural Resources Conservation District (ECNRCD), Northeastern Vermont Development Association (NVDA), Connecticut River Conservancy (CRC), Passumpsic Valley Land Trust, US Department of Agriculture Natural Resources Conservation Service (NRCS), UVM Extension Service, US Fish and Wildlife Service (USFWS), AAFM, Vermont Agency of Transportation (VTrans), lake associations, and municipal groups are active in:

- providing outreach and education to local stakeholders, private landowners, and municipalities.

- developing stream and floodplain protection and restoration projects (e.g., river corridor easements, tree plantings, culvert and bridge upgrades, dam removals, stream channel habitat restoration).
- developing stormwater projects (e.g., Stormwater Master Plans, Road Erosion Inventories, implementation of town road Best Management Practices).
- working with farms in the basin developing and implementing Best Management Practices for water quality,
- monitoring water quality (e.g., lay monitoring program on lakes and rivers).

The work necessary to meet water quality goals in this basin requires collaboration among all these groups to maximize the effectiveness of the watershed partners and the funding investments. Without funding or partners, little of this work would be possible. The Agency is grateful for the active engagement and long-term commitment of so many partner organizations and interested citizens.

## D. Implementation Table

The Implementation Table (Table 11) provides a list of 42 priority strategies created as the go-to implementation guide for watershed action. The provides specificity for where each strategy should focus by identifying priority sub-basins and towns. A list ofrelated individual project entries is found in the online Watershed Projects Database. Projects in the Database vary in level of priority based on the strategies outlined in the table. All projects in the Watershed Projects Database are not expected to be completed over the next five years, but each strategy listed is expected to be implemented and reported upon in future TBPs.

Clean Water Initiative Program clean water project tracking and accounting track progress towards implementing practices in the watershed. Progress achieved through outreach, technical assistance, and project funding will inform DEC's gap analysis to support TMDL implementation. As projects are developed, priority for Clean Water Initiative Program funding is given to those projects that achieve the highest water quality benefits. Projects that provide cumulative benefits (i.e., flood resiliency, water quality improvement, water resource protection, aquatic organism passage) receive additional consideration for prioritization. For these priorities to be achieved, partners and stakeholders must help carry out the strategies identified in the basin plan.

Table 11. Implementation Strategies. Acronyms are listed on Page 95.

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| **Strategies to address runoff from Agricultural Lands** | | | | | |
| 1 | Reestablish meetings of the Caledonia and Essex agricultural workgroup to support the development of Local funding pool applications and to guide BMPs, workshops and outreach efforts to address water quality issues. | Basin wide | All towns | CRFWA, CCNRCD, ECNRCD VAAFM, NRCS, VDEC, UVM Ext. | TBPSG, AGCWIP |
| 2 | Provide technical support to farmers to maintain and implement Nutrient Management Plans (NMPs) and to support participation in AAFM Pay for Performance Program. | Basin wide | All towns | CCNRCD, ECNRCD VAAFM, NRCS, UVM Ext. | EQIP, CSP, AAFM, AGCWIP |
| 3 | Develop a list of locally available equipment necessary for BMP implementation (cover crop, crop to hay conversion, conservation tillage, manure injection) and assist farmers in accessing this equipment through local rental programs, cost-shares, or cooperative applications to funding programs. | Basin wide | All towns | CRFWA, CCNRCD, ECNRCD VAAFM, NRCS, UVM Ext. | RCPP, AGCWIP, VHCB |
| 4 | Increase outreach to farmers to support buffer planting programs across the watershed. | East and West Branch Passumpsic, Millers Run, Passumpsic River, Moose River | Lyndon, Burke, St Johnsbury, Wheelock, Sutton, Concord | CCNRCD, ECNRCD, VAAFM, NRCS, USFW | TBPSG, AGCWIP, AAFM GWFS, NRCS EQIP, FSA CREP, USFW |
| 5 | Provide technical assistance and educational opportunities to support soil health and water quality improvements through Soil Health Assessments, the development and implementation of grazing plans, and pasture and hay land BMPs. | Basin wide | All towns | CCNRCD, ECNRCD, VAAFM, NRCS, UVM Ext. | AGCWIP, EQIP, CSP, VAAFM PSWF |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 6 | Increase outreach to farms with potential natural resource protection opportunities, such as farm conservation, river corridor protection, and wetland restoration. | East and West Branch Passumpsic, Millers Run, Passumpsic River, Moose River | Lyndon, Burke, St Johnsbury, Wheelock, Sutton, Concord | CRFWA, CCNRCD, ECNRCD, NRCS, UVM Ext., CRC, PVLT, VAAFM | TBPSG, AGCWIP, LISFF, Enhancement, UCME, VAAFM CREP |
| 7 | Initiate a discussion of agricultural partners and service providers on how to provide support to farmers to optimize nitrogen application to reduce nitrogen loss and maintain crop yields. | Basin wide | All towns | CRFWA, AAFM, NRCS, CCNRCD, UVM Ext., ECNRCD | AGCWIP, LISFF, TBPSG |
| 8 | Provide technical assistance to small farms on fencing animals out of surface waters and establishing an alternative water supply. | Basin wide | All towns | CRFWA, CCNRCD, ECNRCD, NRCS, UVM Ext., VAAFM | EQIP, CREP, RCPP, VAAFM PSWF, Local funding pool? |
| **Strategies to address runoff from Developed Lands - Stormwater** | | | | | |
| 9 | Evaluate the functioning of existing stormwater projects implemented in the watershed and identify operations and maintenance needs. | St Johnsbury, Lyndonville, Burke, Concord | St Johnsbury, Lyndonville, Burke, Concord | CCNRCD, ECNRCD, NorthWoods, Municipalities | TBPSG |
| 10 | Support the prioritization, design, and implementation of P-efficient stormwater projects in lakes with increasing nutrient trends and N reduction in other areas of the basin. | Basin wide | | CCNRCD, ECNRCD, NorthWoods, Municipalities | TBPSG, Enhancement |
| 11 | Promote campaigns to raise awareness of simple residential stormwater management solutions. | Basin wide | All towns | CCNRCD, ECNRCD, NorthWoods, Municipalities | TBPSG, LISFF |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 12 | Support evaluating and improving town salt and sand storage facilities to improve stormwater management on these sites. | Wheelock, Burke | Wheelock, Burke | CCNRCD, ECNRCD, NVDA, Municipalities | SWMG, GIA |
| **Strategies to address runoff from Developed Lands - Roads** | | | | | |
| 13 | Assist municipalities in updating REI inventories and prioritizing and implementing roads projects to meet the Municipal Roads General Permit (MRGP). | Basin wide | All towns but focus on – Wheelock, Walden, Burke, Newark | CCNRCD, ECNRCD, NVDA, Vtrans, Municipalities | BBR Cat A, |
| 14 | Pilot a GIS road segmentation and private REI to identify, prioritize, develop, and implement private road restoration projects. | Joes Pond, Newark Pond, Bald Hill Pond | Cabot, Danville, Newark, Westmore | CCNRCD, ECNRCD | Enhancement, TBPSG |
| 15 | Complete projects to address erosion issues on Class 4 roads and legal trails. | Basin wide | All towns | CCNRCD, ECNRCD, NVDA, Vtrans, Municipalities | GIA, Enhancement |
| 16 | Host a road forum to debrief with towns on the flood response and provide some information to better support them in the next flood. | Basin wide | All towns | CCNRCD, ECNRCD, NVDA, Vtrans, Municipalities | TPI, TBPSG |
| 17 | Follow up on the meeting with one-on-one support to towns to prepare for the next flood and to identify and support the implementation of flood resilience projects that may overlap with water quality priorites | Basin wide?? | All towns | CCNRCD, ECNRCD, NVDA, Vtrans, Municipalities | TBPSG, GIA, BBR |
| **Strategies to address Wastewater** | | | | | |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 18 | Encourage and support refurbishments and upgrades to public wastewater treatment facilities to help remove nitrogen from discharges. | Basin wide | St Johnsbury, Lyndon, Danville, Lyndonville | DEC, Municipalities | CWSRF, USDA-Rural Development |
| 19 | Provide technical and financial support to the town of St Johnsbury to implement the long-term control plan to address CSOs to the Sleepers and Passumpsic Rivers. | St Johnsbury | St Johnsbury | DEC, St Johnsbury | ARPA, CWSRF, USEPA Engineering Planning Advance, MPG, USDA Community Facilities Program, USDA-RD SEARCH Grant |
| 20 | Educate onsite septic owners about septic system maintenance and alternative systems through local outreach and education programs such as Wastewater Workshops. | Joes Pond and Newark Pond watersheds, Concord and East St Johnsbury | Danville, Newark, Cabot, Concord, St Johnsbury | Municipalities, Lake Associations, | TBPSG |
| **Strategies to support Natural Resource Protection and Restoration - Rivers** | | | | | |
| 21 | Develop priority protection and restoration projects identified in Stream Geomorphic Assessments (SGAs), River Corridor Plans (RCPs), or culvert inventories. | East and West Branches Passumpsic, Millers Run, South Wheelock Branch, Sleepers River, Water Andric | Lyndon, Burke, Newark, East Haven, Wheelock, Sheffield, Danville, | VRP, CRC, CCNRCD, PVLT, NorthWoods | BRICF, DIBG, UCME, USFS, Enhancement, RCEBG, WBBG |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 22 | Continue buffer plantings and floodplain restoration efforts along rivers in priority locations. | SGA/RCP-identified sites or based on landower interest and conservation status | All towns | CCNRCD, ECNRCD, CRC, PVLT, NorthWoods, Danville and Burke CC's | CREP, Enhancement, UCME, WBBG |
| 23 | Pilot the identification, design, and implementation of low tech, process-based restoration projects (beaver dam analogs, post-assisted log structures) to restore fluvial processes in small drainages. | East and West Branches Passumpsic, Millers Run, South Wheelock Branch, Sleepers River, Water Andric | Lyndon, Burke, Newark, East Haven, Wheelock, Sheffield, Danville, | CCNRCD, ECNRCD, CRC, PVLT, NorthWoods, Danville and Burke CC's | CREP, Enhancement, UCME, WBBG |
| 24 | Identify, develop and implement strategic wood addition projects on large private landownerships or where landowners are interested in fish habitat improvement, sediment storage and floodplain connection following ANR technical guidance. | Priority streams upstream of Lyndon but anywhere in the watershed | All towns | ECNRCD, TU, FWD, CRC | Enhancement, UCME |
| 25 | Increase conservation organization capacity to develop and implement river focused strategies in the Passumpsic River watershed. | Basin wide | All towns | CRC, PVLT, CCNRCD, ECNRCD | TBPSG, Ag CWIP, Capacity Building Block Grant |
| 26 | Develop public-facing communications on the importance of co-existing with rivers, including information on the benefits of river corridor protection and floodplain restoration projects. | Basin wide | All towns | DEC, NVDA, CRC, PVLT, CCNRCD, ECNRCD, VRC | TBPSG |
| 27 | Provide technical support for communities to identify and implement floodplain restoration and flood resiliance projects including actions that come out of the Lyndon flood mitigation study. | East and West Branches Passumpsic, Millers Run, Sheldon Brook, Sleepers River, Moose River | Lyndon, St Johnsbury, Danville, Burke, Concord | VRC, FWD, DEC, AAFM, FWR, LCCD, WNRCD, TNC, USFWS | CREP, FEMA, Enhancement, UCME, WBBG |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 28 | Permanently conserve lands through fee ownership or easements that border and protect rivers, streams, wetlands, and headwater areas. | Watersheds upstream of Lyndon and Joes Pond. Upper Moose River Watershed. | Lyndon, Burke, Newark, East Haven, Granby, Wheelock, Sheffield, Kirby, Concord, Victory, Danville, | Bean Brook Conservation Partnership, VLT, PVLT, town CCs | WISPr, |
| 29 | Develop designs and implement USGS weir removal projects. | Sleepers River Watershed | Danville, St Johnsbury | FWD, DEC, CCNRCD, TU, USFWS, CRC, VRC, VNRC | DIBG, NFWF, USFWS, UCME |
| 30 | Remove obsolete dams in the watershed. | Lyndon (Town reservoirs, Lyndon Institute Dam), Sleepers River | Lyndon, Danville | CCNRCD, Lyndon, TU, FWD, CRC | DIBG, NFWF, USFWS, UCME |
| 31 | Complete an assessment of culverts in the watershed that are a priority for restore Aquatic Organism Passage and retrofit or replace priority structures to support passage and geomorphic conditions. | Sleepers River | Danville | CCNRCD, ECNRCD, Towns, TU, FWD, CRC | DIBG, NFWF, USFWS, UCME |
| 32 | Provide outreach to towns and assist them in adopting new FEMA flood maps using state model inundation bylaw or similarly protective language and consider state model river corridor bylaws. | Basin wide | All towns, esp. those without in place. See Municipal Protectiveness Table (Appendix B) | NVDA, DEC, | FEMA, TBPSG |
| 33 | Provide information on the benefits of the NFIP program and the updated maps and technical support for towns that may be interested in joining the NFIP program. | East Branch, Millers Run | Sheffield, Newark, Wheelock, East Haven, Victory, Walden | NVDA, Rivers | FEMA, TBPSG |
| **Strategies to support Natural Resource Protection and Restoration - Lakes** | | | | | |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 34 | Support Lake Watershed Action Plans for priority lakes if there is sufficient community engagement to make assessments successful. | Possibly Joes Pond | Cabot, Danville, Walden | DEC, CCNRCD, Joes Pond Association, Towns | CWIP |
| 35 | Support Lake Wise assessments on priority lakes if sufficient opportunity for community engagement. | Joes Pond, Coles Pond, Bald Hill Pond, Center Pond, Newark Pond. | Cabot, Danville, Newark, Walden | DEC, CCNRCD, Joes Pond Association, Towns | Enhancement Grant, TBPSG |
| 36 | Develop, design, and implement priority projects identified through Lake Wise assessments. | Joes Pond, Coles Pond, Bald Hill Pond, Center Pond, Newark Pond. | Cabot, Danville, Newark, Walden | DEC, CCNRCD, Joes Pond Association, Towns | Enhancement Grant |
| **Strategies to support Natural Resource Protection and Restoration - Wetlands** | | | | | |
| 37 | Increase the identification, landowner outreach, development, and implementation of wetland protection and restoration projects, especially at smaller scales (10-50 acres). | SGA-, RCP-, or RCPP-identified sites | All towns | AAFM, CRC, CCNRCD, ECNRCD | CWI, RCPP, ACEP-WRE |
| 38 | Evaluate opportunities to incorporate adjacent wetlands into the footprints of existing and new river corridor easements. | Basin wide | All towns | Wetlands, Rivers, VRC, CCNRCD, ECNRCD | |
| **Strategies to support Natural Resource Protection and Restoration - Forests** | | | | | |
| 39 | Pilot the identification and prioritization of forest road segments with water quality impacts via the pending Forestland Erosion Assessment tool and subsequent private forest REIs. | State and municipal lands with significant road and stream networks, especially in areas of high runoff potential. Bald Hill Pond, Joes Pond and Newark Pond watersheds | Danville, Cabot, Newark, Westmore, Walden, Victory | DEC, FPR, CCNRCD, ECNRCD, | CWI |

| | Strategy | Priority Area or Watershed | Town(s) | Partner(s) | Funding |
|---|---|---|---|---|---|
| 40 | Develop and implement AMPs and high priority forest road projects on state, municipal, and private lands. | Basin wide; High priority forest REI segments | Danville, Cabot, Newark, Westmore, Walden, Victory | DEC, FPR, CCNRCD, ECNRCD, | CWI, EQIP, RCPP |
| 41 | Coordinate outreach and training on properly implementing the AMPs for practitioners, landowners, and technical service providers, including via local workshops and VAWQP presentations. | Basin wide | All towns | NRCS, UVM ext., VAWQP, FPR LEAP and Master Loggers Program | TBPSG |
| 42 | Reinvigorate skidder bridge programs and increase the use of skidder bridges through direct grants to foresters to purchase skidder bridges. | Basin wide | All towns | FPR, CCNRCD, ECNRCD | CWI |

# E. Monitoring and Assessment Table

The Monitoring and Assessment Table (Table 12) provides a preliminary list of water quality monitoring priorities to guide monitoring over the next five years. Most of these waterbodies were identified as a priority for monitoring in the Basin 15 Basin Assessment Report. The Basin Assessment Report includes many more potential monitoring candidates, but the following waterbodies have been further narrowed down based on local priorities. The ANR's Water Quality Monitoring Strategy describes the monitoring programs supported by ANR and its partners, who are listed in Chapter 2. Common goals for monitoring efforts across programs include identifying water quality conditions, tracking water quality trends, identifying pollution sources, and evaluating improvements over time. The table includes more sites than there is capacity to monitor and as such, will be further prioritized before monitoring occurs.

**Table 12. Priorities For Monitoring and Assessment. Acronyms are listed on Page 153.**

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| **Lakes and Ponds** | | | | |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| Stiles Pond | Chemical monitoring | Waterford | LPMPP; Lay Monitoring | Assessment for nutrient trends. Drinking water supply for St Johnsbury but lake water quality is marginal so additional data may support need for watershed interventions. |
| Joes Pond | Chemical monitoring, chlorophyll-a, Secchi | Danville | LPMPP; Lay Monitoring | Continue tracking increasing nutrient trends. |
| Bald Hill | Chemical monitoring, chlorophyll-a, Secchi | Westmore | LPMPP; Lay Monitoring | Continue tracking increasing nutrient trends. |
| Newark Pond | Chemical monitoring, chlorophyll-a, Secchi | Newark | LPMPP; Lay Monitoring | Continue tracking increasing nutrient trends. Assessment for A1 eligibility. |
| Center Pond | Chemical monitoring, chlorophyll-a, Secchi | Newark | LPMPP; Lay Monitoring | Assessment for A1 eligibility. |
| Keiser Pond | Chemical monitoring, chlorophyll-a, Secchi | Danville | LPMPP; Lay Monitoring | Assessment for A1 eligibility. |
| Marl Pond | Chemical monitoring, chlorophyll-a, Secchi | Sutton | LPMPP; Lay Monitoring | Assessment for A1 eligibility. |
| Identified Lakes and Ponds | Complete AIS survey and plankton net survey | Multiple | LPMPP | Generate AIS status of lakes and ponds with no data. |
| **Rivers and Streams** | | | | |
| Water Andric mile 4.3 – 6.6 | Chemical monitoring, biological monitoring | Danville | LaRosa, BASS | On the edge of meeting WQ conditions, high nutrient loading from WWTF and other sources. |
| Simpson Brook | Chemical monitoring, biological monitoring | Waterford | LaRosa, BASS | Determine impacts to fish community |
| Steam Mill Brook 5.5 | Chemical monitoring, biological monitoring | Walden | LaRosa, BASS | Evaluate fish community and determine potential impacts. |
| Lower Sleepers River | Chemical monitoring | St Johnsbury | LaRosa, BASS | Fairbanks-Morse foundry site: oil spills, other possible contaminants; Parker landfill received hazardous waste; groundwater & stream sediments contain elevated metal concentrations |
| Stiles Brook | Chemical monitoring, biological monitoring | St Johnsbury | LaRosa, BASS | Potential impacts from Agriculture and roads |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| Roberts Brook | Chemical monitoring, biological monitoring | St Johnsbury | LaRosa, BASS | Determine impacts and identify source of sediment |
| Millers Run | Chemical monitoring, biological monitoring | Lyndon | LaRosa, BASS | Determine condition related to sediment and temperature concerns |
| Dish Mill Tributary 2 | Chemical monitoring, biological monitoring | Burke | LaRosa, BASS | Determine condition related to elevated sediment levels previously identified |
| Dish Mill Brook | Chemical monitoring, biological monitoring | Burke | LaRosa, BASS | Determine condition related to sediment and stormwater runoff from ski area development |
| Roundy Brook | Chemical monitoring, biological monitoring | Burke | LaRosa, BASS | Determine condition related to sediment related to road impacts |
| Rake Factory Brook, 2.3 | Biological monitoring | Danville | BASS | Determine potential for enhanced protection. |
| Kirby Brook, 1.1 | Biological monitoring | Concord | BASS | Determine potential for enhanced protection. |
| Roy Brook, 1.3 | Biological monitoring | Danville | BASS | Determine potential for enhanced protection. |
| Sleepers River 6.8 | Biological monitoring | Danville | BASS | Determine potential for enhanced protection. |
| Barns Brook, 0.1 | Biological monitoring | Kirby | BASS | Determine potential for enhanced protection. |
| Nation Brook, 0.8 | Biological monitoring | Sheffield | BASS | Determine potential for enhanced protection. |
| Calendar Brook Trib 22 | Biological monitoring | Sheffield | BASS | Determine potential for enhanced protection. |
| Clark Brook, 0.2 | Biological monitoring | Sheffield | BASS | Determine potential for enhanced protection. |
| Sutton River, 0.1 | Biological monitoring | Sutton | BASS | Determine potential for enhanced protection. |
| Acadia Brook, 0.3 | Biological monitoring | Newark | BASS | Determine potential for enhanced protection. |
| Upper East Branch | Biological monitoring, chemical monitoring | East Haven | BASS, LaRosa | Data gap in large watershed 62km^2 that is a potential very high-quality water. |
| Morill Brook | Biological monitoring, chemical monitoring | Danville | BASS, LaRosa | Data gap in large watershed 22km^2 with 15% agricultural and developed lands. |
| Hay Hill Brook | Biological monitoring, chemical monitoring | Victory, Lunenburg | BASS, LaRosa | Data gap in moderate sized watershed with less than 1% agricultural and developed lands. |
| Fall Brook | Biological monitoring, chemical monitoring | Lyndon | BASS, LaRosa | Data gap in moderate watershed 13 km^2 with 13% agricultural and developed lands and issues with road runoff in the watershed. |
| Newark Creek (Officially an unnamed stream) | Biological monitoring, chemical monitoring | Burke, Newark | BASS, LaRosa | Data gap in small watershed (7 km^2) with 14% agricultural (farmstead and lots of corn result in elevated ground water nitrogen levels) and |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| | | | | developed lands. |
| Square Brook | Biological monitoring, chemical monitoring | Sheffield | BASS, LaRosa | Data gap in small watershed 10k^2 with more than 12% agricultural and developed lands. |
| Pope Brook | Biological monitoring, chemical monitoring | Danville | BASS, LaRosa | Data gap in small watershed 10k^2 with more than 20% agricultural and developed lands. |
| Lyford Brook | Biological monitoring, chemical monitoring | Danville | BASS, LaRosa | Data gap in small watershed 10k^2 with over 20% agricultural and developed lands. Also, significant tributary to Joes Pond that has increasing nutrient trends |
| Brown Brook South | Biological monitoring, chemical monitoring | Danville | BASS, LaRosa | Data gap in small watershed 12k^2 with just under 20% agricultural and developed lands. |
| James Brook | Biological monitoring, chemical monitoring | Victory | BASS, LaRosa | Data gap in small sized watershed (10km^2) with less than 1% agricultural and developed lands. Potential very high-quality water. |
| Flower Brook | Biological monitoring, chemical monitoring | Burke | BASS, LaRosa | Data gap in small sized watershed (9km^2) with less than 1% agricultural and developed lands. Potential very high-quality water. |
| Water Andric | Fisheries monitoring | Danville | FWD | Determine potential for enhanced protection. |
| Brown Brook | Fisheries monitoring | Danville | FWD | Determine potential for enhanced protection. |
| Burroughs Brook | Fisheries monitoring | Danville | FWD | Determine potential for enhanced protection. |
| Dexter Brook | Fisheries monitoring | Sheffield | FWD | Determine potential for enhanced protection. |
| Dish Mill Brook | Fisheries monitoring | Burke | FWD | Determine potential for enhanced protection. |
| Dolloff Inlet | Fisheries monitoring | Sutton | FWD | Determine potential for enhanced protection. |
| Hawkins Brook | Fisheries monitoring | Kirby | FWD | Determine potential for enhanced protection. |
| Joes Brook trib | Fisheries monitoring | Danville | FWD | Determine potential for enhanced protection. |
| Nation Brook Trib #3 | Fisheries monitoring | Sutton | FWD | Determine potential for enhanced protection. |
| Morrill Brook | Fisheries monitoring | Danville | FWD | Determine potential for enhanced protection. |
| Nation Brook | Fisheries monitoring | Sutton | FWD | Determine potential for enhanced protection. |
| Pope Brook | Fisheries monitoring | Danville | FWD | Determine potential for enhanced protection. |
| South Wheelock Branch | Fisheries monitoring | Wheelock | FWD | Determine potential for enhanced protection. |
| Umpire Brook | Fisheries monitoring | Victory | FWD | Determine potential for enhanced protection. |
| **Wetlands** | | | | |
| High-quality wetlands (other | Wetland assessment | Multiple | Wetlands | Assessment for Class I wetland eligibility. |

| Waterbody | Project Description | Location | Partner(s) | Purpose |
|---|---|---|---|---|
| than Victory Bog Wetlands Complex) proposed by local communities | | | | |

# List of Acronyms

| | |
|---|---|
| 319 | Federal Clean Water Act, Section 319 |
| 604(b) | Federal Clean Water Act, Section 604b |
| A(1) | Class A(1) Water Management |
| A(2) | Class A(2) Water Management |
| AAFM | Agency of Agriculture, Food and Markets |
| ACEP-WRE | Agricultural Conservation Easement Program – Wetland Reserve Easements |
| AGCWIP | Agricultural Clean Water Initiative Grant Program (VAAFM) |
| AIS | Aquatic Invasive Species |
| AMP | Acceptable Management Practice |
| ANR | Agency of Natural Resources |
| ARPA | American Rescue Plan Act |
| B(1) | Class B(1) Water Management |
| B(2) | Class B(2) Water Management |
| BASS | Biomonitoring and Aquatic Studies Section, DEC Watershed Management Division |
| BMP | Best Management Practice |
| CCNRCD | Caledonia County Natural Resource Conservation District |
| CRC | Connecticut River Conservancy |
| CREP | Conservation Reserve Enhancement Program (VAAFM) |
| CWI | Clean Water Initiative |
| CWIP | Clean Water Initiative Program |
| CWSP | Clean Water Service Provider |
| CWSRF | Clean Water State Revolving Fund |
| DEC | Department of Environmental Conservation |
| DIBG | Design-Implementation Block Grant |
| ECNRCD | Essex County Natural Resources Conservation District |
| EPA | US Environmental Protection Agency |
| EQIP | Environmental Quality Incentive Program |
| ERAF | Emergency Relief and Assistance Fund |
| FEMA | Federal Emergency Management Agency |
| FFI | Functioning Floodplain Initiative |
| FPR | Vermont Forests, Parks and Recreation |
| FWD | Vermont Fish & Wildlife Department |
| GIA | Grants-in-Aid |
| LPMPP | Lake and Ponds Management and Protection Program |
| LWAP | Lake Watershed Action Plan |
| MRGP | Municipal Roads General Permit |
| MS4 | Municipal Separate Storm Sewer System |
| NFWF | National Fish and Wildlife Foundation |
| NGLA | Next Generation Lake Assessment |
| NPDES | National Pollutant Discharge Elimination System |
| NRCD | Natural Resource Conservation District |
| NRCS | Natural Resources Conservation Service |
| NVDA | Northeastern Vermont Development Association |
| ORW | Outstanding Resource Water |
| PDBG | Project Development Block Grant |

| | |
|---|---|
| PFW | Partners for Fish and Wildlife |
| PVLT | Passumpsic Valley Land Trust |
| RAP | Required Agricultural Practice |
| RCEBG | River Corridor Easement Block Grant |
| RCP | River Corridor Plan |
| RCPP | Regional Conservation Partnership Program |
| REI | Road Erosion Inventory |
| SFY | State Fiscal Year |
| SGA | Stream Geomorphic Assessment |
| SWA | Strategic Wood Addition |
| SWG | State Wildlife Grant |
| SWMG | Stormwater Management Grant |
| SWMP | Stormwater Master Plan |
| SOP | Standard Operating Procedure |
| TBP | Tactical Basin Plan |
| TBPSG | Tactical Basin Planning Support Grant |
| TMDL | Total Maximum Daily Load |
| TNC | The Nature Conservancy |
| TP | Total Phosphorus |
| TS4 | Transportation Separate Storm Sewer System Permit |
| TU | Trout Unlimited |
| UCME | Upper Connecticut Mitigation and Enhancement Fund |
| USDA | United States Department of Agriculture |
| USEPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service |
| UVA | Use Value Appraisal program, or Current Use Program |
| UVM Ext. | University of Vermont Extension |
| VAWQP | Vermont Agricultural Water Quality Partnership |
| VLT | Vermont Land Trust |
| VNRC | Vermont Natural Resources Council |
| VRAM | Vermont Rapid (Wetland) Assessment Method |
| VRC | Vermont River Conservancy |
| VSA | Vermont Statutes Annotated |
| VTrans | Vermont Agency of Transportation |
| VWQS | Vermont Water Quality Standards |
| WBBG | Woody Buffer Block Grant |
| WSMD | Watershed Management Division |
| WWTF | Wastewater Treatment Facility |

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# Appendix A. Dams in the Passumpsic Basin

**Table A1. List of dams in the Passumpsic basin. These dams are either in service, partially breached, breached, or removed. Source: Vermont Dam Inventory (accessed: 06/07/2024).**

| Dams ID | Dam Name | Stream | Dam Status | Purposes | Hazard Potential |
|---|---|---|---|---|---|
| 49 | Passumpsic | Passumpsic River | In Service | Hydroelectric | Low |
| 50 | Roy Bros. Mfg. Co. | Passumpsic River | In Service | Hydroelectric | Low |
| 53 | Barnet-7 | Joes Brook | Removed | | |
| 181 | East Burke (Lumber Co.) | East Branch Passumpsic River | Removed | Other | |
| 182 | Coe Brothers | West Branch Passumpsic River | Removed | | |
| 183 | Browns Mill | West Branch Passumpsic River | Removed | | |
| 185 | Burke-7 | Roundy Brook | In Service | | Minimal |
| 186 | Burke Mtn. Snow Pond | Dish Mill Brook-TR | In Service | | Minimal |
| 283 | Smith Granite Co. | Moose River | Removed | | |
| 284 | Lee | Moose River | Removed | | |
| 287 | Mill Pond | Moose River-TR | In Service | | Minimal |
| 302 | Danville-1 | Joes Pond-TR | In Service | | Minimal |
| 303 | West Danville No. 15 | Joes Brook | In Service | Hydroelectric; Recreation | Low |
| 304 | Danville Reservoir | Brown Brook | In Service | | Low |
| 305 | Keiser Pond | Sawyer Brook | In Service | Recreation | Low |
| 306 | Morses Mill | Joes Brook | Removed | | |
| 307 | Daniel, Clifford and James | Joes Brook | Removed | | |
| 309 | Danville-8 | Joes Brook | Removed | | |
| 310 | Danville-9 | Joes Brook | Removed | | |
| 311 | Fairbanks Morse | Sleepers River | Breached | | |
| 312 | Frye Pond | Brown Brook-TR | In Service | Recreation | Low |
| 313 | Frye Pond Upper | Brown Brook-TR | In Service | Recreation | Minimal |
| 504 | Johnson Pond | Moose River-TR | Breached (Partial) | | Low |
| 543 | Institute Pond | Passumpsic River-TR | In Service | Other | High |
| 544 | Great Falls | Passumpsic River | In Service | Hydroelectric | Low |
| 545 | Vail | Passumpsic River | In Service | Hydroelectric | Low |
| 546 | Fay Young Reservoir | Squabble Hollow Brook | In Service | | Minimal |
| 547 | Lyndon State College (Lower) | Passumpsic River-TR | Breached | | |
| 548 | Lyndon State College (Middle) | Passumpsic River-TR | In Service | Recreation | Minimal |
| 549 | Lyndon State College (Upper) | Passumpsic River-TR | In Service | Recreation | Significant |
| 550 | Woodworth Reservoir | South Wheelock Branch-TR | In Service | | Minimal |
| 551 | Ice Pond (Upper) | Miller Run-TR | In Service | | Minimal |

| Dams ID | Dam Name | Stream | Dam Status | Purposes | Hazard Potential |
|---|---|---|---|---|---|
| **552** | Ice Pond (Lower) | Miller Run-TR | In Service | | Minimal |
| **553** | Whitcomb Mill | South Wheelock Branch | Removed | | |
| **554** | Lyndon-13 | South Wheelock Branch | Breached | | |
| **555** | Lyndon-14 | East Branch Passumpsic River | Breached | | |
| **556** | Grays Pond | Passumpsic River-TR | In Service | | Minimal |
| **646** | Bean Brook (Upper) | Bean Brook | Removed | | |
| **647** | Bean Brook (Lower) | Bean Brook | Removed | | |
| **650** | Sleeper Brook | Sleeper Brook | Removed | | |
| **651** | Bald Hill Fish Hatchery Upper | Bean Brook-TR | In Service | | Minimal |
| **652** | Bald Hill Fish Hatchery Lower | Bean Brook | In Service | | Minimal |
| **653** | Bald Hill Hatchery Rearing Pond Lower | Bean Brook - OS | In Service | | Minimal |
| **654** | Bald Hill Hatchery Rearing Pond Upper | Bean Brook - OS | In Service | | Minimal |
| **727** | Tinkers Pond | Peacham Hollow Brook-TR | In Service | Recreation | Low |
| **853** | Arnold Falls | Passumpsic River | In Service | Hydroelectric | Low |
| **854** | Bay Street | Passumpsic River | Removed | | |
| **855** | Gage | Passumpsic River | In Service | Hydroelectric | Low |
| **856** | Crow Hill (Lower) | Sleepers River-TR | In Service | | Minimal |
| **857** | Crow Hill (Upper) | Sleepers River-TR | In Service | | Minimal |
| **858** | American Fork and Hoe | Moose River | Breached | | |
| **859** | Davies and Manton-Gaylin | Moose River | Removed | | |
| **860** | East St. Johnsbury | Moose River | Breached | | |
| **863** | St. Johnsbury Center | Passumpsic River | Breached | | |
| **864** | Pierce Mills | Passumpsic River | In Service | Hydroelectric | Low |
| **865** | Fairbanks Scale Co. | Sleepers River | Removed | | |
| **866** | U.S. Fish Hatchery | Sleepers River | In Service | Hydroelectric | |
| **902** | Sheffield | Miller Run | Removed | | |
| **1071** | Stanley Brook | Stanley Brook | Removed | | |
| **1076** | Goslants Mill | Steam Mill Brook | Breached (Partial) | Other | |
| **1100** | Stiles Pond | Stiles Brook | In Service | Water Supply | High |
| **1105** | Waterford-6 | Stiles Pond-TR | In Service | | Minimal |
| **1155** | Chandler Pond | South Wheelock Branch-TR | In Service | Water Supply | Significant |
| **1156** | Buckley | Miller Run | Removed | | |
| **1157** | Weed | Miller Run | Removed | Hydroelectric | Low |

# Appendix B. Passumpsic Basin Municipal Protectiveness Table

**Table B1. Surface-water related protections adopted by municipalities predominantly in the Passumpsic basin.**

| | National Flood Insurance Program (NFIP) | River Corridor Protection | Road and Bridge Standards | Emergency Operations Plan (LEOP) | Hazard Mitigation Plan (LHMP) | ERAF | Stormwater Master Plan | Illicit Discharge Detection and Elimination | Stormwater Mapping |
|---|---|---|---|---|---|---|---|---|---|
| | Status | Adopted? | Adopted? | Completed? | Adopted? | Percent | Completed? | Completed? | Completed? |
| **Barnet** | Yes | No | Yes | No | No | 7.5% | NA | Yes | NA |
| **Burke** | Yes | Yes | Yes | No | Yes | 7.5% | Yes | Yes | Yes |
| **Concord** | Yes | No | Yes | No | Expired | 7.5% | Yes | Yes | Yes |
| **Danville** | Yes | No | Yes | Yes | Yes | 12.5% | No | Yes | Yes |
| **East Haven** | No | No | Yes | Yes | No | 7.5% | NA | NA | NA |
| **Granby** | Yes | Yes | Yes | No | Yes | 7.5% | NA | NA | NA |
| **Kirby** | Yes | Yes | Yes | Yes | Yes | 17.5% | NA | NA | NA |
| **Lyndon** | Yes | Yes | Yes | Yes | Yes | 17.5% | Yes | Yes | Yes |
| **Newark** | No | No | Yes | Yes | No | 7.5% | NA | NA | NA |
| **Sheffield** | No | No | Yes | No | Yes | 7.5% | NA | No | Yes |
| **St. Johnsbury** | Yes | No | Yes | Yes | Expired | 7.5% | Yes | Yes | Yes |
| **Stannard** | Yes | No | No | No | No | 7.5% | NA | NA | NA |
| **Sutton** | Yes | No | Yes | No | Yes | 7.5% | NA | NA | NA |
| **Victory** | No | No | Yes | Yes | Expired | 7.5% | NA | NA | NA |
| **Walden** | No | No | Yes | Yes | Yes | 7.5% | NA | NA | NA |
| **Waterford** | Yes | No | Yes | Yes | Yes | 12.5% | NA | NA | NA |
| **Westmore** | No | No | Yes | Yes | No | 7.5% | NA | NA | NA |